

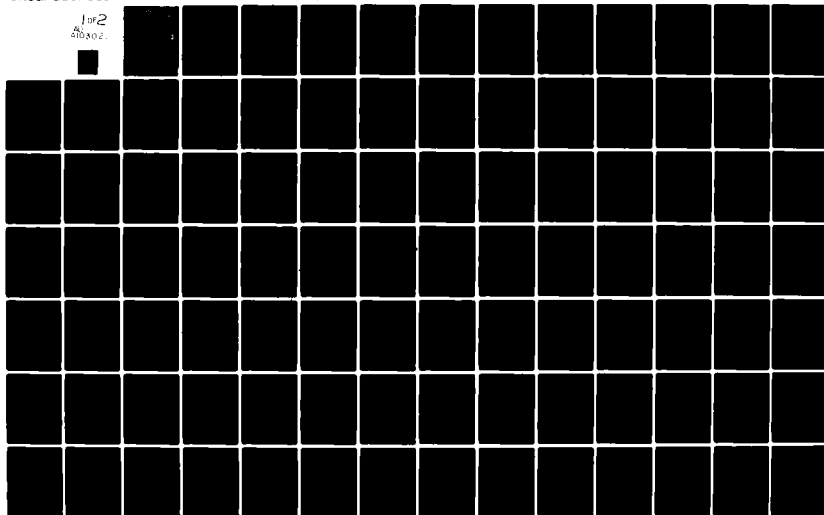
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DAVID W. TAYLOR NAVAL SHIP  
RESEARCH AND DEVELOPMENT CENTER



Bethesda, Maryland 20084

COMPUTER CENTER CDC LIBRARIES

by

David V. Sommer

and

Sharon E. Good

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Computation, Mathematics and Logistics Department  
Departmental Report

February 1981

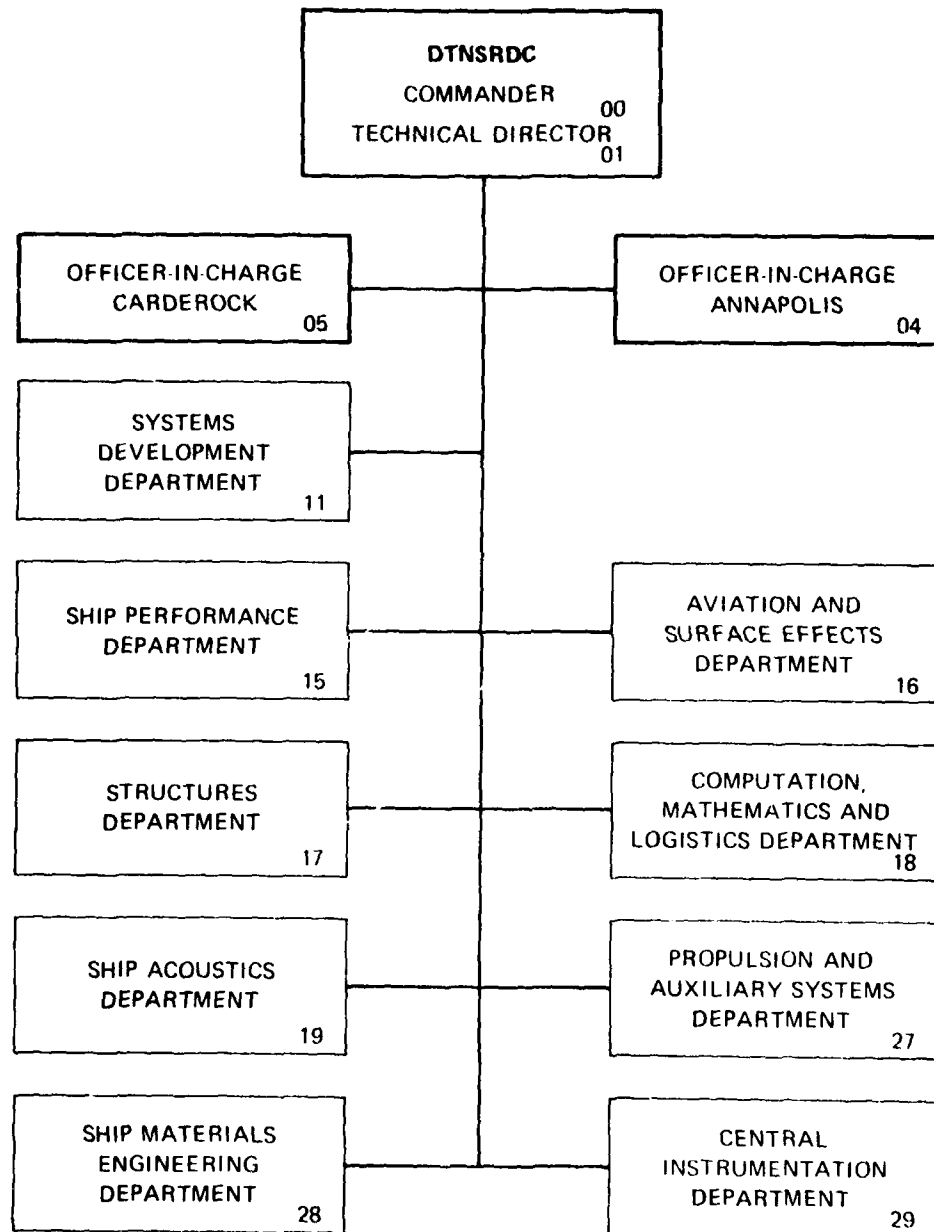
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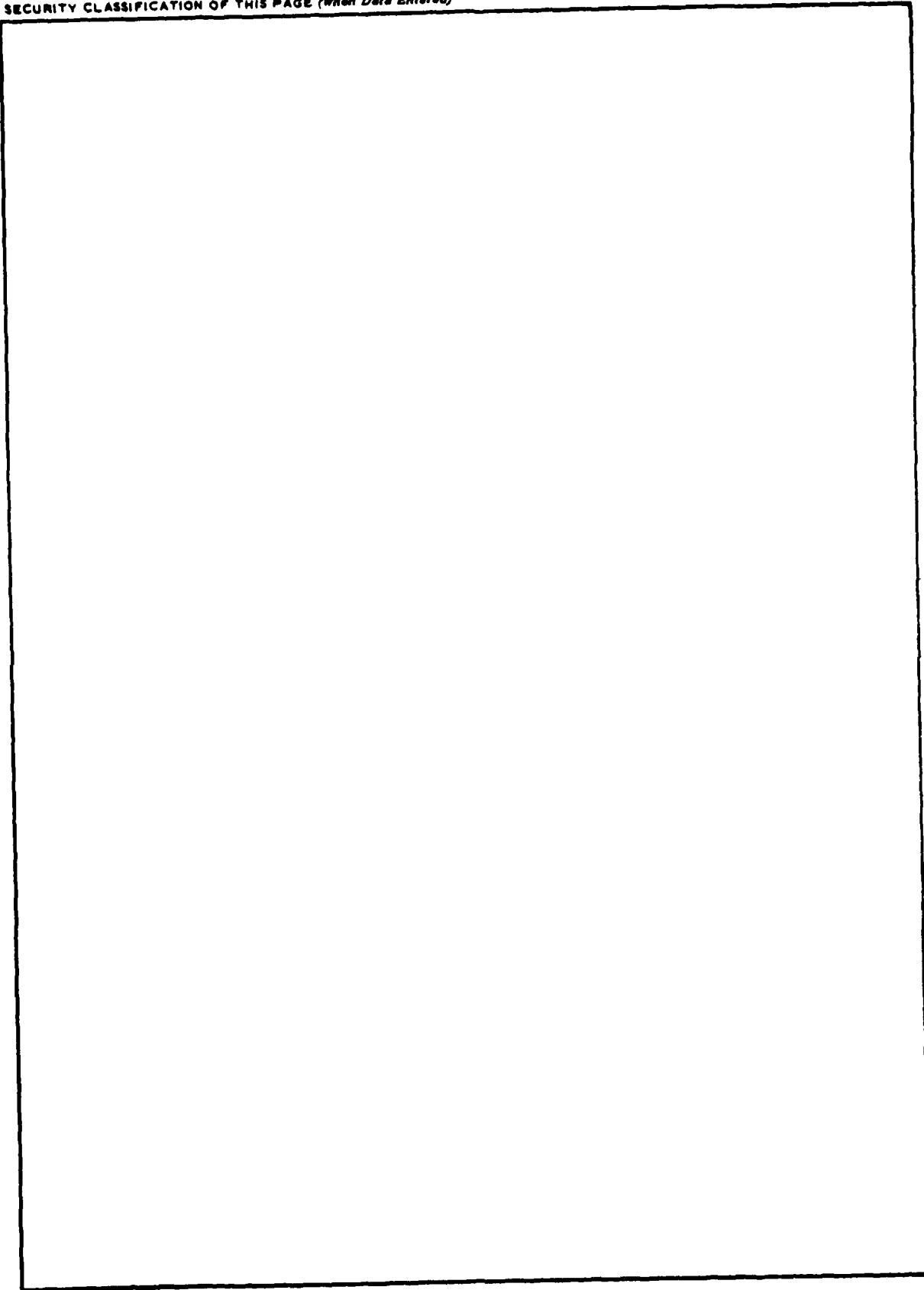
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DAVID W. TAYLOR  
NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER  
BETHESDA, MARYLAND 20084

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\* COMPUTER CENTER CDC LIBRARIES \*  
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BY  
DAVID V SOMMER  
SHARON E GOOD  
USER SERVICES BRANCH

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COMPUTATION, MATHEMATICS AND LOGISTICS DEPARTMENT  
DEPARTMENTAL REPORT

FEBRUARY 1981

CMLD-81-06

THROUGH REVISION 0 (FEB 1981)

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## \*\*\*\*\* INTRODUCTION \*\*\*\*\*

THE COMPUTER CENTER MAKES AVAILABLE ON THE CDC COMPUTERS, IN ADDITION TO THE NOS/BE OPERATING SYSTEM, A WIDE VARIETY OF BOTH SCIENTIFIC AND UTILITY PROGRAMS, SUBPROGRAMS AND CATALOGUED PROCEDURES. MOST OF THE ROUTINES ARE MAINTAINED IN LIBRARIES ON PERMANENT FILES AND MAY BE INVOKED BY THE APPROPRIATE (LOADER) CONTROL CARDS. A FEW PROGRAMS ARE AVAILABLE AS INDEPENDENT PERMANENT FILES.

THE CLIB-SERIES OF MANUALS CONSISTS OF THE FOLLOWING, WHICH DESCRIBE THE CONTENTS OF THE VARIOUS CDC 6000 LIBRARIES MAINTAINED BY THE COMPUTER CENTER:

CLIB	- COMPUTER CENTER CDC LIBRARIES	CMLD-81-06
CLIB/N	- COMPUTER CENTER CDC LIBRARIES/NSRDC (SUBPROGRAMS)	CMLD-81-07
CLIB/P	- COMPUTER CENTER CDC LIBRARIES/PROCFIL (PROCEDURES)	CMLD-81-08
CLIB/U	- COMPUTER CENTER CDC LIBRARIES/UTILITY (PROGRAMS)	CMLD-81-09
CLIB/M	- COMPUTER CENTER CDC LIBRARIES/MNSRDC (PROGRAMS)	

THIS MANUAL, CLIB, IS A CROSS-REFERENCE MANUAL WHICH DESCRIBES ALL THE LIBRARIES AND INDICATES A SOURCE FOR MORE COMPLETE DOCUMENTATION ON HOW TO USE THE ROUTINES IN THE LIBRARIES. REFERENCES MAY BE TO OTHER PUBLISHED BOOKS, MACHINE-READABLE DOCUMENTATION OR MASTER COPIES ON FILE IN USER SERVICES. THE OTHER MANUALS IN THIS SERIES CONTAIN MACHINE-READABLE DOCUMENTS.

ALL REFERENCE MATERIAL IS AVAILABLE FOR PERUSAL IN USER SERVICES (CARDEROCK: BLDG 17, ROOM 100, (202) 227-1907; ANNAPOLIS: BLDG 100, ROOM 2-J, (301) 267-3343). COPIES OF THE CLIB-SERIES MAY BE OBTAINED FROM USER SERVICES.

## \*\*\* HOW TO USE THIS MANUAL \*\*\*

THE ROUTINES ARE CLASSIFIED IN ONE OR MORE FUNCTIONAL CATEGORIES (SEE PAGE 1-3 FOR A LIST OF CATEGORIES). THEY ARE LISTED, BEGINNING ON PAGE 1-6, UNDER THE VARIOUS CATEGORIES. EACH ENTRY IN THIS LIST INDICATES THE TYPE OF ROUTINE, THE LIBRARY (IF ANY) WHERE IT MAY BE FOUND, AND THE LOCATION OF THE DETAILED DOCUMENT WHICH DESCRIBES ITS USE.

THE ROUTINES LISTED IN THIS MANUAL ARE DIVIDED BY TYPE (PROGRAM, SUBPROGRAM OR CATALOGUED PROCEDURE), IN CHAPTERS 2, 3 AND 4, RESPECTIVELY. THESE CHAPTERS DESCRIBE THE VARIOUS LIBRARIES AVAILABLE AND LIST THE ROUTINES IN EACH LIBRARY (WITH A DESCRIPTIVE TITLE) ALPHABETICALLY.



## \*\*\* HOW TO PRINT INDIVIDUAL DOCUMENTS \*\*\*

INDIVIDUAL DOCUMENTS FOR MANY ROUTINES MAY BE PRINTED BY ONE OF THE FOLLOWING:

- 1) FOR LIBRARIES NSRDC, PROCFIL, UTILITY, MNSRDC, OTHER\*:

```
JOBNAME,....  
CHARGE,....  
BEGIN,DOCGET,,<LIBRARY>,,<ROUTINE>,OUTPUT.
```

- 2) FOR LIBRARIES ARLNALG, EISPACK, FUNPACK, IMSL, MINPACK:

```
JOBNAME,MT1,....  
CHARGE,....  
BEGIN,DOCTAPE,,<LIBRARY>,<ROUTINE>,OUTPUT.
```

WHERE <LIBRARY> IS THE LIBRARY CONTAINING THE ROUTINE  
<ROUTINE> IS THE NAME OF THE ROUTINE WHOSE DOCUMENTATION IS  
DESIRED.

\* - PSEUDO-LIBRARY 'OTHER' IS A COLLECTION OF MISCELLANEOUS DOCUMENTS  
NOT PRINTED IN ANY MANUAL (SEE PAGE 2-11).

## \*\*\* FUNCTIONAL CATEGORIES \*\*\*

THE FOLLOWING FUNCTIONAL CATEGORIES ARE USED AT DTNSRDC. THOSE PRECEDED BY AN ASTERISK (\*) ARE LOCAL DTNSRDC CATEGORIES. ALL OTHERS ARE FROM THE VIM (THE CDC USERS GROUP) LIST.

- A0 ARITHMETIC ROUTINES
- A1 REAL NUMBERS
- A2 COMPLEX NUMBERS
- A3 DECIMAL
- A4 I/O ROUTINES
  
- B0 ELEMENTARY FUNCTIONS
- B1 TRIGONOMETRIC
- B2 HYPERBOLIC
- B3 EXPONENTIAL AND LOGARITHMIC
- B4 ROOTS AND POWERS
  
- C0 POLYNOMIALS AND SPECIAL FUNCTIONS
- C1 EVALUATION OF POLYNOMIALS
- C2 ROOTS OF POLYNOMIALS
- C3 EVALUATION OF SPECIAL FUNCTIONS (NON-STATISTICAL)
- C4 SIMULTANEOUS NON-LINEAR ALGEBRAIC EQUATIONS
- C5 SIMULTANEOUS TRANSCENDENTAL EQUATIONS
- \* C6 ROOTS OF FUNCTIONS
  
- D0 OPERATIONS ON FUNCTIONS AND SOLUTIONS OF DIFFERENTIAL EQUATIONS
- D1 NUMERICAL INTEGRATION
- D2 NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS
- D3 NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS
- D4 NUMERICAL DIFFERENTIATION
  
- E0 INTERPOLATION AND APPROXIMATIONS
- E1 TABLE LOOK-UP AND INTERPOLATION
- E2 CURVE FITTING
- E3 SMOOTHING
- E4 MINIMIZING OR MAXIMIZING A FUNCTION
  
- F0 OPERATIONS ON MATRICES, VECTORS & SIMULTANEOUS LINEAR EQUATIONS
- F1 VECTOR AND MATRIX OPERATIONS
- F2 EIGENVALUES AND EIGENVECTORS
- F3 DETERMINANTS
- F4 SIMULTANEOUS LINEAR EQUATIONS
  
- G0 STATISTICAL ANALYSIS AND PROBABILITY
- G1 DATA REDUCTION (COMMON STATISTICAL PARAMETERS)
- G2 CORRELATION AND REGRESSION ANALYSIS
- G3 SEQUENTIAL ANALYSIS
- G4 ANALYSIS OF VARIANCE
- G5 TIME SERIES
- G6 SPECIAL FUNCTIONS (INCLUDES RANDOM NUMBERS AND PDF'S)
- \* G7 MULTIVARIATE ANALYSIS AND SCALE STATISTICS
- \* G8 NON-PARAMETRIC METHODS AND STATISTICAL TESTS
- \* G9 STATISTICAL INFERENCE

H0 OPERATIONS RESEARCH TECHNIQUES, SIMULATION & MANAGEMENT SCIENCE  
H1 LINEAR PROGRAMMING  
H2 NON-LINEAR PROGRAMMING  
H3 TRANSPORTATION AND NETWORK CODES  
H4 SIMULATION MODELING  
H5 SIMULATION MODELS  
H6 CRITICAL PATH PROGRAMS  
H8 AUXILIARY PROGRAMS  
H9 COMBINED

I0 INPUT  
I1 BINARY  
I2 OCTAL  
I3 DECIMAL  
I4 BCD (HOLLERITH)  
I9 COMPOSITE

J0 OUTPUT  
J1 BINARY  
J2 OCTAL  
J3 DECIMAL  
J4 BCD (HOLLERITH)  
J5 PLOTTING  
J7 ANALOG  
J9 COMPOSITE

K0 INTERNAL INFORMATION TRANSFER  
K1 EXTERNAL-TO-EXTERNAL  
K2 INTERNAL-TO-INTERNAL (RELOCATION)  
K3 DISK  
K4 TAPE  
K5 DIRECT DATA DEVICES

L0 EXECUTIVE ROUTINES  
L1 ASSEMBLY  
L2 COMPILING  
L3 MONITORING  
L4 PREPROCESSING  
L5 DISASSEMBLY AND DERELATIVIZING  
L6 RELATIVIZING  
L7 COMPUTER LANGUAGE TRANSLATORS

M0 DATA HANDLING  
M1 SORTING  
M2 CONVERSION AND/OR SCALING  
M3 MERGING  
M4 CHARACTER MANIPULATION  
M5 SEARCHING, SEEKING, LOCATING  
M6 REPORT GENERATORS  
M9 COMPOSITE

N0 DEBUGGING  
N1 TRACING AND TRAPPING  
N2 DUMPING  
N3 MEMORY VERIFICATION AND SEARCHING  
N4 BREAKPOINT PRINTING

00 SIMULATION OF COMPUTERS AND DATA PROCESSORS (INTERPRETERS)  
01 OFF-LINE EQUIPMENT (LISTERS, REPRODUCERS, ETC.)  
03 COMPUTERS  
04 PSEUDO-COMPUTERS  
05 SOFTWARE SIMULATION OF PERIPHERALS  
09 COMPOSITE

P0 DIAGNOSTICS (HARDWARE MALFUNCTION)

Q0 SERVICE OR HOUSEKEEPING, PROGRAMMING AIDS  
Q1 CLEAR/RESET  
Q2 CHECKSUM ACCUMULATION AND CORRECTION  
Q3 FILE MANIPULATION  
Q4 INTERNAL HOUSEKEEPING, SAVE, RESTORE, ETC.  
Q5 REPORT GENERATOR SUBROUTINES  
Q6 PROGRAM DOCUMENTATION: FLOW CHARTS, DOCUMENT STANDARDIZATION  
Q7 PROGRAM LIBRARY UTILITIES

R0 LOGIC AND SYMBOLIC  
R1 FORMAL LOGIC  
R2 SYMBOL MANIPULATION  
R3 LIST AND STRING PROCESSING  
R4 TEXT EDITING

S0 INFORMATION RETRIEVAL

T0 APPLICATIONS AND APPLICATION-ORIENTED PROGRAMS  
T1 PHYSICS (INCLUDING NUCLEAR)  
T2 CHEMISTRY  
T3 OTHER PHYSICAL SCIENCES (GEOLOGY, ASTRONOMY, ETC.)  
T4 ENGINEERING  
T5 BUSINESS DATA PROCESSING  
T6 MANUFACTURING (NON-DATA) PROCESSING AND PROCESS CONTROL  
T7 MATHEMATICS AND APPLIED MATHEMATICS  
T8 SOCIAL AND BEHAVIORAL SCIENCES AND PSYCHOLOGY  
T9 BIOLOGICAL SCIENCES  
T10 REGIONAL SCIENCES (GEOGRAPHY, URBAN PLANNING)  
T11 COMPUTER ASSISTED INSTRUCTION

U0 LINGUISTICS AND LANGUAGES

V0 GENERAL PURPOSE UTILITY SUBROUTINES  
V1 RANDOM NUMBER GENERATORS  
V2 COMBINATORIAL GENERATORS: PERMUTATIONS, COMBINATIONS & SUBSETS  
\* V3 STANDARD AND SPECIAL PROBLEMS

X0 DATA REDUCTION  
X1 RE-FORMATTING, DECOMMUTATION, ERROR DIAGNOSIS  
X2 EDITING  
X3 CALIBRATION  
X4 EVALUATION  
X5 ANALYSIS (TIME-SERIES ANALYSIS)  
X6 SIMULATION (GENERATE TEST DATA FOR DATA REDUCTION SYSTEM)

Y0 INSTALLATION MODIFICATION  
Y1 INSTALLATION MODIFICATION LIBRARY  
Y2 NEWPL TAPE OF INSTALLATION MODIFICATIONS

Z0 ALL OTHERS

## \*\*\* LIST OF ROUTINES BY FUNCTIONAL CATEGORY \*\*\*

THE FOLLOWING IS A LIST OF ROUTINES DISCUSSED IN THE CLIB SERIES OF MANUALS. EACH ROUTINE APPEARS UNDER THE CATEGORY(IES) TO WHICH IT HAS BEEN ASSIGNED.

EACH ENTRY HAS THE FOLLOWING FORM:

NAME/TYPE/LIB/DOC/

WHERE NAME IS THE ROUTINE NAME  
(MAY BE ABBREVIATED TO FIT INTO 7 CHARACTERS (SPSS))

TYPE IS THE KIND OF ROUTINE  
D - MAIN PROGRAM ACTIVATED BY A DATA CARD (SPSS)  
M - MAIN PROGRAM  
P - PROCEDURE  
S - SUBPROGRAM

LIB IS THE LIBRARY CONTAINING THE ROUTINE  
(THE NUMBER IN PARENTHESES FOLLOWING EACH LIBRARY NAME BELOW IS THE PAGE IN THIS MANUAL WHERE THE LIBRARY IS DISCUSSED)

A - ARLNALG (3-2)  
B - BIMED (2-1)  
C - BIMEDP (2-3)  
D - SANDIA (3-67)  
E - EISPACK (3-4)  
F - FUNPACK (3-8)  
I - IMSL (3-10)  
K - MINPACK (3-36)  
L - LINPACK (3-33)  
M - MSL (3-37)  
N - NSRDC (3-57)  
P - PROCFIL (4-1)  
R - MNSRDC (2-4)  
S - SPSS (2-5)  
T - PASCAL (2-12)  
U - UTILITY (2-7)  
BLANK - NOT IN A LIBRARY

DOC INDICATES THE MANUAL WHERE THE ROUTINE IS DOCUMENTED  
M - CLIB/MNSRDC (PROGRAMS)  
N - CLIB/NSRDC (SUBPROGRAMS)  
P - CLIB/PROCFIL (PROCEDURES)  
R - CCRM (COMPUTER CENTER REFERENCE MANUAL)  
(MAY CONTAIN ENOUGH INFORMATION TO USE THE ROUTINE OR A FURTHER REFERENCE.)  
U - CLIB/UTILITY (PROGRAMS)  
\* - USER SERVICES MAY HAVE THE DOCUMENT  
BLANK - FOR DOCUMENTATION LOCATION, SEE THE DISCUSSION OF THAT LIBRARY IN THIS MANUAL

## A0 ARITHMETIC ROUTINES

FAFRAC /S/M/ /  
FFRAC /S/M/ /  
FMFRAC /S/M/ /

HCF /S/M/ /  
ICOMN /S/N/\*/ /  
LCM /S/M/ /

VDCPS /S/I/ /

## A1 REAL NUMBERS

AMCON /S/M/ /  
DASUM /S/I/ /

ISUMIT /S/N/N/ /  
NFILL /S/N/N/ /

SUMIT /S/N/N/ /

## A2 COMPLEX NUMBERS

CADR /S/M/ /  
CBAREX /S/M/ /  
CCOMPE /S/M/ /  
CCONGR /S/M/ /  
CDERIV /S/M/ /  
CFBSUM /S/M/ /  
CGITRF /S/M/ /  
CGLESM /S/M/ /  
CINPRD /S/M/ /  
CINT /S/M/ /  
CITERF /S/M/ /  
CLDIV /S/M/ /  
CMPINV /S/N/N/ /  
CMPYR /S/M/ /  
CNSLVL /S/M/ /

COMBES /S/M/ /  
CPDIV /S/M/ /  
CPOLRT /S/M/ /  
CPTRAN /S/M/ /  
CQDIV /S/M/ /  
CREV /S/M/ /  
CSBR /S/M/ /  
CSHRNK /S/M/ /  
ELRH1C /S/I/ /  
ELRH2C /S/I/ /  
ELZHC /S/I/ /  
ELZVC /S/I/ /  
HARM /S/M/ /  
HELP /S/M/ /  
HELP /S/N/N/ /

MULLP /S/M/ /  
POLYMUL /M/R/M/ /  
PSI /S/N/\*/ /  
SASUM /S/I/ /  
SCASUM /S/I/ /  
SUBDIA /S/M/ /  
VALVEC /S/M/ /  
VECORD /S/M/ /  
ZAFUJ /S/M/ /  
ZAFUM /S/M/ /  
ZAFUR /S/M/ /  
ZCOUNT /S/M/ /  
ZCPOLY /S/I/ /  
ZQADC /S/I/ /  
ZQADR /S/I/ /

## B0 ELEMENTARY FUNCTIONS

DNRM2 /S/I/ /

## B1 TRIGONOMETRIC

COTAN /S/N/\*/ /

SICI /S/M/ /

## B3 EXPONENTIAL AND LOGARITHMIC

CBAREX /S/M/ /

## B4 ROOTS AND POWERS

DPROOT /S/N/N/ /

PROOT /S/N/N/ /

SUMPS /S/M/ /

## C1 EVALUATION OF POLYNOMIALS

ADR /S/M/ /  
APOWR /S/N/\*/ /  
BPOWR /S/N/\*/ /  
CADR /S/M/ /  
CCOMPE /S/M/ /  
CDERIV /S/M/ /  
CLDIV /S/M/ /  
CMPYR /S/M/ /  
CNSLVL /S/M/ /  
COMPEV /S/M/ /  
COSEVL /S/M/ /  
CPDIV /S/M/ /  
CPTRAN /S/M/ /

CQDIV /S/M/ /  
CREV /S/M/ /  
CSBR /S/M/ /  
CSHRNK /S/M/ /  
DERIV /S/M/ /  
EVREAL /S/M/ /  
FMULT1 /S/M/ /  
HIFAC /S/N/\*/ /  
IBCEVU /S/I/ /  
ICSEVU /S/I/ /  
LDIV /S/M/ /  
MPYR /S/M/ /  
NSLVL /S/M/ /

PARFAC /S/M/ /  
PDIV /S/M/ /  
POLDIV /S/N/\*/ /  
POWR1 /S/N/\*/ /  
POWR2 /S/N/\*/ /  
PROD2 /S/N/\*/ /  
PTRAN /S/M/ /  
QDIV /S/M/ /  
REV /S/M/ /  
SBR /S/M/ /  
SHRINK /S/M/ /  
SINEVL /S/M/ /

## C2 ROOTS OF POLYNOMIALS

CINT	/S/M/ /	MULLP	/S/M/ /	ZCPOLY	/S/I/ /
CPOLRT	/S/M/ /	NROOTS	/S/N/*/	ZPOLR	/S/I/ /
DPROOT	/S/N/N/	POLYMUL	/M/R/M/	ZQADC	/S/I/ /
HELP	/S/M/ /	PROOT	/S/M/ /	ZQADR	/S/I/ /
HELP	/S/N/N/	PROOT	/S/N/N/	ZRPOLY	/S/I/ /
INT	/S/M/ /	QUART	/S/N/*/		

## C3 EVALUATION OF SPECIAL FUNCTIONS (NON-STATISTICAL)

AI	/S/N/*/	COMBES	/S/M/ /	GAMMA	/S/N/N/
ALGAMA	/S/I/ /	COMBES	/S/N/*/	HANKEL	/S/M/ /
BEJY0	/S/N/*/	DAW	/S/F/ /	LOGGAM	/S/M/ /
BEJY1	/S/N/*/	E1	/S/F/ /	LOGGAM	/S/N/*/
BESE10	/S/F/ /	ELF	/S/M/ /	MERFC1	/S/I/ /
BESE11	/S/F/ /	ELIEM	/S/F/ /	MERFI	/S/I/ /
BESEK0	/S/F/ /	ELIE1	/S/F/ /	MMBS10	/S/I/ /
BESEK1	/S/F/ /	ELIKM	/S/F/ /	MMBS11	/S/I/ /
BES10	/S/F/ /	ELIK1	/S/F/ /	MMBSJ0	/S/I/ /
BES11	/S/F/ /	ELIPE	/S/F/ /	MMBSJ1	/S/I/ /
BESJ0	/S/F/ /	ELIPK	/S/F/ /	MMBSK0	/S/I/ /
BESJ1	/S/F/ /	ELK	/S/M/ /	MMBSK1	/S/I/ /
BESK0	/S/F/ /	ELLI	/S/N/*/	MMBSYN	/S/I/ /
BESK1	/S/F/ /	ELLIP	/S/N/*/	MMDAS	/S/I/ /
BESN1S	/S/M/ /	EL3	/S/M/ /	MMDEI	/S/I/ /
BESNKS	/S/M' /	EONE	/S/F/ /	MMDELE	/S/I/ /
BESS1	/S/N/N/	ERF	/S/I/ /	MMDELK	/S/I/ /
BESSJ	/S/N/N/	ERF	/S/M/ /	MMKELD	/S/I/ /
BESSK	/S/N/N/	ERF	/S/N/*/	MMKELO	/S/I/ /
BESSY	/S/N/N/	ERFC	/S/I/ /	MMKEL1	/S/I/ /
BESY	/S/F/ /	ERFINV	/S/M/ /	MMPSI	/S/I/ /
BSJ	/S/M/ /	ERROR	/S/N/*/	NBESJ	/S/M/ /
BSJ	/S/N/N/	EXPEI	/S/F/ /	PSI	/S/F/ /
CBSF	/S/N/*/	EXPINT	/S/N/*/	PSI	/S/N/*/
CE13	/S/N/*/	FRESNEL	/S/N/N/	RBESY	/S/M/ /
CELL1	/S/N/N/	GAMAIN	/S/M/ /	SNCNDN	/S/N/N/
CEL3	/S/M/ /	GAMCAR	/S/N/N/	VCONVO	/S/I/ /
CHEBEV	/S/M/ /	GAMMA	/S/I/ /	YNU	/S/F/ /
CHTOL	/S/M/ /	GAMMA	/S/M/ /		

## C4 SIMULTANEOUS NON-LINEAR ALGEBRAIC EQUATIONS

HYBRD	/S/K/ /	NEWT	/S/M/ /	RQNW	/S/M/ /
HYBRD1	/S/K/ /	NONLIQ	/S/M/ /	ZSYSTEM	/S/I/ /
HYBRJ	/S/K/ /	NRSG	/S/M/ /		
HYBRJ1	/S/K/ /	QNW	/S/M/ /		

## C5 SIMULTANEOUS TRANSCENDENTAL EQUATIONS

QNW	/S/M/ /	RQNW	/S/M/ /
-----	---------	------	---------

## C6 ROOTS OF FUNCTIONS

ROOTER	/S/N/*/	ZANLYT	/S/I/ /	ZREAL1	/S/I/ /
ZAFUJ	/S/M/ /	ZBRENT	/S/I/ /	ZREAL2	/S/I/ /
ZAFUM	/S/M/ /	ZCOUNT	/S/M/ /		
ZAFUR	/S/M/ /	ZFALSE	/S/I/ /		

# D0 OPERATIONS ON FUNCTIONS AND SOLUTIONS OF DIFFERENTIAL EQUATIONS

## D1 NUMERICAL INTEGRATION

DBCEVU /S/I/ /	HERMIT /S/M/ /	SICI /S/M/ /
DBCQDU /S/I/ /	LAGRAN /S/M/ /	SIMP /S/N/*/
DBLINT /S/I/ /	LAGUER /S/M/ /	SIMPRC /S/M/ /
DCADRE /S/I/ /	LEGEND /S/M/ /	SIMPUN /S/N/N/
DCSQDU /S/I/ /	PARBL /S/M/ /	TRGINT /S/M/ /
FGI /S/N/*/	QUAD /S/M/ /	UNCSPL /S/M/ /
FNOL3 /S/N/*/	QUADG /S/N/N/	XFIL /S/N/*/
GMI /S/M/ /	ROMBG /S/M/ /	

## D2 NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

DE /S/D/ /	DREBS /S/I/ /	FNOL3 /S/N/*/
DEROOT /S/D/ /	DTPTB /S/I/ /	KUTMER /S/N/N/
DGEAR /S/I/ /	DVERK /S/I/ /	STEP /S/D/ /

## D3 NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

BLCKDQ /S/M/ /	LINBVP /S/M/ /	RKINIT /S/M/ /
BVP /S/M/ /	NRKVS /S/M/ /	
DRATEX /S/M/ /	NRKVSH /S/M/ /	

## D4 NUMERICAL DIFFERENTIATION

CDERIV /S/M/ /	DERIV /S/M/ /	LAGDIF /S/M/ /
DCSEVU /S/I/ /	DIFTAB /S/M/ /	TRGDIF /S/M/ /

## E0 INTERPOLATION AND APPROXIMATIONS

COSEVL /S/M/ /	SINEVL /S/M/ /	ZSRCH /S/I/ /
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## E1 TABLE LOOK-UP AND INTERPOLATION

ACFI /S/M/ /	ICSCCU /S/I/ /	RICH /S/M/ /
AITKEN /S/M/ /	ICSICU /S/I/ /	SEARCH /S/M/ /
ATSM /S/M/ /	ICSPLN /S/I/ /	SINSER /S/M/ /
CRDTAB /S/N/*/	IQHSCU /S/I/ /	TBLU1 /S/M/ /
DISCOT /S/N/N/	IQHSCV /S/I/ /	TBLU2 /S/M/ /
FRMRAN /S/N/*/	IRATCU /S/I/ /	TBLU3 /S/M/ /
FRMRA2 /S/N/*/	LAGINT /S/M/ /	TERP1 /S/M/ /
HRMT1 /S/M/ /	NRICH /S/M/ /	TERP2 /S/M/ /
HRMT2 /S/M/ /	ORTHON /S/M/ /	TERP3 /S/M/ /
IBCIEU /S/I/ /	PRICH /S/M/ /	



## E2 CURVE FITTING

BSUBHT /S/M/ /	FFT3D /S/I/ /	LSQHTS /S/M/ /
CCONGR /S/M/ /	FFT5 /S/N/N/	LSQSIT /S/M/ /
CDECOM /S/M/ /	FHRNEW /S/M/ /	LSQSUB /S/N/*/
CFQME /S/M/ /	FITLIN /S/M/ /	OPLSA /S/N/N/
CHEBAP /S/M/ /	FLGNEW /S/M/ /	ORTHFT /S/M/ /
CHEBEV /S/M/ /	FLINV /S/I/ /	PLAGR /S/M/ /
COMCUB /S/M/ /	FLSQFY /S/M/ /	PLRG /M/R/M/
CTLLF /S/I/ /	FOURAP /S/M/ /	POLYN /S/N/N/
CUBIC2 /S/M/ /	FOURI /S/M/ /	PRONY /S/M/ /
CURV /S/M/ /	GMHAS /S/N/*/	RFFT /S/N/N/
DIFTAB /S/M/ /	GMI /S/M/ /	RFSN /S/N/N/
FCGM2 /S/M/ /	IBCICU /S/I/ /	SPLFIT /S/N/*/
FCLSQ /S/M/ /	ICSFKU /S/I/ /	SPLINE /S/M/ /
FDLSQ /S/M/ /	ICSVKU /S/I/ /	SQFIT /S/N/*/
FFT /S/N/N/	IFLSSQ /S/I/ /	SQRSL /S/L/ /
FFTCC /S/I/ /	ITRLSQ /S/M/ /	SURFS /S/M/ /
FFTRC /S/I/ /	LINWOOD /M/ /R/	UNCSPL /S/M/ /
FFT2C /S/I/ /	LSQHTM /S/M/ /	

## E3 SMOOTHING

ICSMOU /S/I/ /	MILN2 /S/M/ /	SMOOTH /S/M/ /
ICSSCU /S/I/ /	SIGSMT /S/M/ /	SMOOTH /S/N/*/
ICSSV /S/I/ /	SMOCUB /S/M/ /	

## E4 MINIMIZING OR MAXIMIZING A FUNCTION

CHKDER /S/K/ /	LMSTR1 /S/K/ /	ZXGSN /S/I/ /
LMDER /S/K/ /	MIGEN /S/M/ /	ZXGSP /S/I/ /
LMDER1 /S/K/ /	MINMAX /S/N/*/	ZXMIN /S/I/ /
LMDF /S/K/ /	MINRAT /S/M/ /	ZXSSQ /S/I/ /
LMDF1 /S/K/ /	ZSCNT /S/I/ /	
LMSTR /S/K/ /	ZXCGR /S/I/ /	

## F0 OPERATIONS ON MATRICES, VECTORS &amp; SIMULTANEOUS LINEAR EQUATIONS

SGECO /S/L/ /

## F1 VECTOR AND MATRIX OPERATIONS

BALANC /S/E/ /	LEQ2C /S/I/ /	USCRDM /S/I/ /
BALANC /S/M/ /	LEQ2S /S/I/ /	USMNMX /S/I/ /
BANDR /S/E/ /	LU1 /S/A/ /	USRDM /S/I/ /
BCHSDC /S/M/ /	LU2 /S/A/ /	USRDV /S/I/ /
BDCWNP /S/M/ /	LU3 /S/A/ /	USWBM /S/I/ /
BDECOM /S/M/ /	LU4 /S/A/ /	USWBS /S/I/ /
BDTRGI /S/I/ /	LU5 /S/A/ /	USWFM /S/I/ /
BDTRGO /S/I/ /	LU6 /S/A/ /	USWFV /S/I/ /
BMD10S /M/B/ /	MATINS /S/N/N/	USWSM /S/I/ /
CAXPY /S/I/ /	MINFIT /S/E/ /	VABMXF /S/I/ /
CBAL /S/E/ /	ORTHES /S/E/ /	VABMXS /S/I/ /
CCOPY /S/I/ /	ORTHO /S/A/ /	VABSMF /S/I/ /
CDECOM /S/M/ /	ORTHO2 /S/A/ /	VABSMS /S/I/ /
CDOTC /S/I/ /	ORTAN /S/E/ /	VCONVO /S/I/ /
CDOTU /S/I/ /	PRDSUM /S/M/ /	VCVTBF /S/I/ /
CHSDEC /S/M/ /	QZHES /S/E/ /	VCVTCH /S/I/ /
CINPRD /S/M/ /	QZIT /S/E/ /	VCVTFB /S/I/ /
COMHES /S/E/ /	RAYLGH /S/M/ /	VCVTFQ /S/I/ /

## F1 VECTOR AND MATRIX OPERATIONS (CONTINUED)

CORTH /S/E/ /	RLSUBM /S/I/ /	VCVTFS /S/I/ /
CSCAL /S/I/ /	RLSUM /S/I/ /	VCVTHC /S/I/ /
CSSCAL /S/I/ /	SAXPY /S/I/ /	VCVTQF /S/I/ /
CSWAP /S/I/ /	SCHDC /S/L/ /	VCVTQS /S/I/ /
CZDOTC /S/I/ /	SCHDD /S/L/ /	VCVTSF /S/I/ /
CZDOTU /S/I/ /	SCHEX /S/L/ /	VCVTSQ /S/I/ /
DAXPY /S/I/ /	SCHUD /S/L/ /	VHSH2C /S/I/ /
DCBHT /S/M/ /	SCNRM2 /S/I/ /	VHSH2R /S/I/ /
DCOPY /S/I/ /	SCOPY /S/I/ /	VHSH3R /S/I/ /
DCWNE /S/M/ /	SDOT /S/I/ /	VHS12 /S/I/ /
DCWNP /S/M/ /	SDSDOT /S/I/ /	VIP /S/M/ /
DDOT /S/I/ /	SGBCO /S/L/ /	VIPA /S/M/ /
DECOM /S/M/ /	SGBFA /S/L/ /	VIPD /S/M/ /
DROT /S/I/ /	SGEFA /S/L/ /	VIPDA /S/M/ /
DROTG /S/I/ /	SMTVX /S/M/ /	VIPDS /S/M/ /
DROTM /S/I/ /	SMVX /S/M/ /	VIPRFF /S/I/ /
DROTMG /S/I/ /	SNRM2 /S/I/ /	VIPRSS /S/I/ /
DSCAL /S/I/ /	SPBCO /S/L/ /	VIPS /S/M/ /
DSDOT /S/I/ /	SPBFA /S/L/ /	VMULBB /S/I/ /
DSWAP /S/I/ /	SPDCOM /S/M/ /	VMULBF /S/I/ /
EBALAC /S/I/ /	SPOCO /S/L/ /	VMULBS /S/I/ /
EBALAF /S/I/ /	SPOFA /S/L/ /	VMULFB /S/I/ /
ELMHES /S/E/ /	SPPCO /S/L/ /	VMULFF /S/I/ /
ELTRAN /S/E/ /	SPPFA /S/L/ /	VMULFM /S/I/ /
FABSV /S/M/ /	SQRDC /S/L/ /	VMULFP /S/I/ /
FCOMB /S/M/ /	SQRSL /S/L/ /	VMULFQ /S/I/ /
FIG1 /S/E/ /	SROT /S/I/ /	VMULFS /S/I/ /
FIG12 /S/E/ /	SROTG /S/I/ /	VMULQB /S/I/ /
FIP /S/A/ /	SROTM /S/I/ /	VMULQF /S/I/ /
FMMX /S/M/ /	SROTMG /S/I/ /	VMULQQ /S/I/ /
FMTMX /S/M/ /	SSCAL /S/I/ /	VMULQS /S/I/ /
FMTR /S/M/ /	SSICO /S/L/ /	VMULSB /S/I/ /
FMTVCX /S/M/ /	SSIFA /S/L/ /	VMULSF /S/I/ /
FMTVX /S/M/ /	SSPCO /S/L/ /	VMULSQ /S/I/ /
FMVCX /S/M/ /	SSPFA /S/L/ /	VMULSS /S/I/ /
FMVX /S/M/ /	SSVDC /S/L/ /	VNRMF1 /S/I/ /
FNORM1 /S/M/ /	SSWAP /S/I/ /	VNRMF1 /S/I/ /
FPUR /S/M/ /	STRCO /S/L/ /	VNRMF2 /S/I/ /
HSSN /S/M/ /	SUBDIA /S/M/ /	VNRMS1 /S/I/ /
HTRIDI /S/E/ /	SUBDIR /S/M/ /	VNRMS2 /S/I/ /
HTRID3 /S/E/ /	SVD /S/A/ /	VPOLYF /S/I/ /
ICAMAX /S/I/ /	SVD /S/E/ /	VTPROF /S/I/ /
IDAMAX /S/I/ /	TRED1 /S/E/ /	VTPROS /S/I/ /
INRPRD /S/M/ /	TRED2 /S/E/ /	VTRAN /S/I/ /
ISAMAX /S/I/ /	TRED3 /S/E/ /	VUABQ /S/I/ /
ITERIN /S/M/ /	TRIDI /S/M/ /	VUAFB /S/I/ /
LEQT1B /S/I/ /	TRI1 /S/A/ /	VUAFQ /S/I/ /
LEQT1C /S/I/ /	TRI2 /S/A/ /	VUAFS /S/I/ /
LEQT2B /S/I/ /	TRI3 /S/A/ /	VUASB /S/I/ /
LEQ1S /S/I/ /	TRI4 /S/A/ /	VUASQ /S/I/ /

## F2 EIGENVALUES AND EIGENVECTORS

BAC1	/S/A/ /	EIGRS	/S/I/ /	RECOV1	/S/M/ /
BAC2	/S/A/ /	EIGSYM	/S/M/ /	RECOV2	/S/M/ /
BAKVEC	/S/E/ /	EIGVCH	/S/M/ /	REDSY1	/S/M/ /
BALBAK	/S/E/ /	EIGZC	/S/I/ /	REDSY2	/S/M/ /
BANDV	/S/E/ /	EIGZF	/S/I/ /	REDUC	/S/E/ /
BANEIG	/S/M/ /	EIG5	/S/M/ /	REDUC1	/S/A/ /
BISEC	/S/A/ /	ELMBAK	/S/E/ /	REDUC2	/S/E/ /
BISECT	/S/E/ /	ELRH1C	/S/I/ /	RG	/S/E/ /
BQR	/S/E/ /	ELRH2C	/S/I/ /	RGG	/S/E/ /
CBABK2	/S/E/ /	ELZHC	/S/I/ /	RITZIT	/S/A/ /
CG	/S/E/ /	ELZVC	/S/I/ /	RNQL1	/S/A/ /
CH	/S/E/ /	EQRH1F	/S/I/ /	RS	/S/E/ /
CINVT	/S/E/ /	EQRH3F	/S/I/ /	RSB	/S/E/ /
COMBAK	/S/E/ /	EQRT1S	/S/I/ /	RSG	/S/E/ /
COMLR	/S/E/ /	EQRT2S	/S/I/ /	RSGAB	/S/E/ /
COMLR2	/S/E/ /	EQRT3S	/S/I/ /	RSGBA	/S/E/ /
COMQR	/S/E/ /	EQZQF	/S/I/ /	RSP	/S/E/ /
COMQR2	/S/E/ /	EQZTF	/S/I/ /	RST	/S/E/ /
CORTB	/S/E/ /	EQZVF	/S/I/ /	RT	/S/E/ /
DEIG	/S/M/ /	HQR	/S/E/ /	SEPAR	/S/M/ /
DTSHFT	/S/M/ /	HQR2	/S/E/ /	SEPAR2	/S/M/ /
EBALAC	/S/I/ /	HTRIBK	/S/E/ /	SIMP	/S/M/ /
EBALAF	/S/I/ /	HTRIB3	/S/E/ /	SYMLR	/S/M/ /
EBBCKC	/S/I/ /	IMQL1	/S/A/ /	SYMQR	/S/M/ /
EBBCKF	/S/I/ /	IMTQLV	/S/E/ /	TCDIAG	/S/M/ /
EBCKCF	/S/I/ /	IMTQL1	/S/E/ /	TINVIT	/S/E/ /
EBCKKH	/S/I/ /	IMTQL2	/S/E/ /	TQLRAT	/S/E/ /
EHSSC	/S/I/ /	INIT	/S/A/ /	TQL1	/S/E/ /
EHSSF	/S/I/ /	INVIT	/S/E/ /	TQL2	/S/E/ /
EHOBKS	/S/I/ /	LATNTR	/S/M/ /	TRBAK1	/S/E/ /
EHOUH	/S/I/ /	ORTBAK	/S/E/ /	TRBAK3	/S/E/ /
EHOUSS	/S/I/ /	QREIGN	/S/M/ /	TRIDIB	/S/E/ /
EIGBS	/S/I/ /	QZABX	/S/A/ /	TSTURM	/S/E/ /
EIGCC	/S/I/ /	QZVAL	/S/E/ /	VALVEC	/S/M/ /
EIGCH	/S/I/ /	QZVEC	/S/E/ /	VARAH1	/S/N/* /
EIGCHK	/S/M/ /	RATQR	/S/E/ /	VARAH2	/S/N/* /
EIGCO1	/S/M/ /	REBAK	/S/E/ /	VECTOR	/S/M/ /
EIGIMP	/S/M/ /	REBAKA	/S/A/ /		
EIGRF	/S/I/ /	REBAKB	/S/E/ /		

## F3 DETERMINANTS

BPDSOM	/S/M/ /	LITWNE	/S/M/ /	SPITRM	/S/M/ /
DETERM	/S/M/ /	LITWNP	/S/M/ /	SPITRS	/S/M/ /
GAUSS	/S/N/N/	MATINS	/S/N/N/	SPODI	/S/L/ /
LESWNE	/S/M/ /	PDITRM	/S/M/ /	SPPDI	/S/L/ /
LESWNP	/S/M/ /	PDITRS	/S/M/ /	SSIDI	/S/L/ /
LINSYS	/S/M/ /	SGBDI	/S/L/ /	SSPDI	/S/L/ /
LINV3F	/S/I/ /	SGEDI	/S/L/ /	STRDI	/S/L/ /
LINV3P	/S/I/ /	SPBDI	/S/L/ /		

## F4 SIMULTANEOUS LINEAR EQUATIONS

BFBANP /S/M/ /	LEQT1C /S/I/ /	ORSOL /S/A/ /
BFBSUM /S/M/ /	LEQT1F /S/I/ /	PDITRM /S/M/ /
BITERM /S/M/ /	LEQT1P /S/I/ /	PDITRS /S/M/ /
BITRFM /S/M/ /	LEQT2B /S/I/ /	PDLSDM /S/M/ /
BITRNP /S/M/ /	LEQT2F /S/I/ /	PDLSDS /S/M/ /
BITRPD /S/M/ /	LEQT2P /S/I/ /	PDSFBM /S/M/ /
BITWNP /S/M/ /	LEQ1PB /S/I/ /	PDSFBS /S/M/ /
BLESOM /S/M/ /	LEQ1S /S/I/ /	QR1 /S/M/ /
BLSWNP /S/M/ /	LEQ2C /S/I/ /	RQNWT /S/M/ /
BMAM /S/N/*/	LEQ2PB /S/I/ /	SCONG /S/M/ /
BPDITM /S/M/ /	LEQ2S /S/I/ /	SGBSL /S/L/ /
BPDSFB /S/M/ /	LESWNE /S/M/ /	SGEDI /S/L/ /
BPDSOM /S/M/ /	LESWNP /S/M/ /	SGESL /S/L/ /
BSUBHT /S/M/ /	LGINF /S/I/ /	SGTSL /S/L/ /
CCONGR /S/M/ /	LINSYS /S/M/ /	SPBSL /S/L/ /
CFBSUM /S/M/ /	LINV1F /S/I/ /	SPDFBM /S/M/ /
CGAUSS /S/N/N/	LINV1P /S/I/ /	SPDFBS /S/M/ /
CGITRF /S/M/ /	LINV2F /S/I/ /	SPDSOM /S/M/ /
CGLESM /S/M/ /	LINV2P /S/I/ /	SPDSOS /S/M/ /
CITERF /S/M/ /	LINV3F /S/I/ /	SPITRM /S/M/ /
CMPINV /S/N/N/	LINV3P /S/I/ /	SPITRS /S/M/ /
FBSUBM /S/M/ /	LIN1PB /S/I/ /	SPODI /S/L/ /
FBSUBS /S/M/ /	LIN2PB /S/I/ /	SPDSL /S/L/ /
FCGM2 /S/M/ /	LITWNE /S/M/ /	SPPDI /S/L/ /
GAUSS /S/N/N/	LITWNP /S/M/ /	SPPSL /S/L/ /
GITRFM /S/M/ /	LLBQF /S/I/ /	SPTSL /S/L/ /
GITRFS /S/M/ /	LLSQF /S/I/ /	SQRDC /S/L/ /
GLESOM /S/M/ /	LSQHTM /S/M/ /	SSIDI /S/L/ /
GLESOS /S/M/ /	LSQHTS /S/M/ /	SSISL /S/L/ /
IMPR1 /S/A/ /	LSQSIT /S/M/ /	SSPDI /S/L/ /
IMPR2 /S/A/ /	LSVDB /S/I/ /	SSPSL /S/L/ /
INVERS /S/M/ /	LSVDF /S/I/ /	STRDI /S/L/ /
INVITR /S/M/ /	LUDAPB /S/I/ /	STRSL /S/L/ /
ITERFM /S/M/ /	LUDATF /S/I/ /	TRDCNP /S/M/ /
ITERFS /S/M/ /	LUDECP /S/I/ /	TRDCOM /S/M/ /
ITRPDM /S/M/ /	LUELMF /S/I/ /	TRDFBM /S/M/ /
ITRPDS /S/M/ /	LUELMP /S/I/ /	TRDSOM /S/M/ /
ITRSPM /S/M/ /	LUELPB /S/I/ /	TRDSUB /S/M/ /
ITRSPS /S/M/ /	LUREFF /S/I/ /	TRDWNP /S/M/ /
LEQS1 /S/A/ /	LUREFP /S/I/ /	TRILOM /S/M/ /
LEQS2 /S/A/ /	LUREPB /S/I/ /	TRILOS /S/M/ /
LEQS3 /S/A/ /	MAM /S/N/*/	TRIUPM /S/M/ /
LEQS4 /S/A/ /	MAM200 /S/N/*/	TRIUPS /S/M/ /
LEQS5 /S/A/ /	MATINS /S/N/N/	TRLOIN /S/M/ /
LEQS6 /S/A/ /	OFIMA3 /S/I/ /	TRUPIN /S/M/ /
LEQT1B /S/I/ /	ORIMP /S/A/ /	

## G0 STATISTICAL ANALYSIS AND PROBABILITY

BMD01S /M/B/ /	BMD12S /M/B/ /	USLEAP /S/I/ /
BMD03S /M/B/ /	BMD13S /M/B/ /	USTREE /S/I/ /
BMD09S /M/B/ /	BMD14S /M/B/ /	ZRMN /S/M/ /
BMD10S /M/B/ /	EDIT /D/S/ /	
BMD11S /M/B/ /	OMNITAB/M/ /R/	

## G1 DATA REDUCTION (COMMON STATISTICAL PARAMETERS)

AGGREGA/D/S/ /	BMDP1D /M/C/ /	FILTER /S/M/ /
AGLMOD /S/I/ /	BMDP2D /M/C/ /	FREQUEN/D/S/ /
AMEANS /S/I/ /	BMDP3D /M/C/ /	GTMTNT /S/I/ /
AORDR /S/I/ /	BMDP4D /M/C/ /	MULT RE/D/S/ /
BDCOU1 /S/I/ /	BMDP5D /M/C/ /	OP1RAY /S/M/ /
BDCOU2 /S/I/ /	BMDP6D /M/C/ /	OP2RAY /S/M/ /
BDLTV /S/I/ /	BMDP7D /M/C/ /	REPORT /D/S/ /
BECOR /S/I/ /	BMDP8D /M/C/ /	SSPAND /S/I/ /
BECORI /S/I/ /	BMDP9D /M/C/ /	SSPBLK /S/I/ /
BECVVM /S/I/ /	BMD01D /M/B/ /	SSRAND /S/I/ /
BECVL /S/I/ /	BMD04D /M/B/ /	SSRBLK /S/I/ /
BECVLI /S/I/ /	BMD05D /M/B/ /	SSSAND /S/I/ /
BEGRPS /S/I/ /	BMD06D /M/B/ /	SSSBLK /S/I/ /
BEIGRP /S/I/ /	BMD07D /M/B/ /	SSSCAN /S/I/ /
BEIUGR /S/I/ /	BMD10D /M/B/ /	SSSEST /S/I/ /
BELBIN /S/I/ /	BMD11D /M/B/ /	STUTEE /S/N/* /
BELPOS /S/I/ /	BMD13D /M/B/ /	T-TEST /D/S/ /
BEMDP /S/I/ /	BREAKDO/D/S/ /	USBOX /S/I/ /
BEMIRI /S/I/ /	CONDESC/D/S/ /	USHIST /S/I/ /
BEMIRO /S/I/ /	DLETE /S/M/ /	USHIUT /S/I/ /
BEMMI /S/I/ /	DSCRPT /S/M/ /	USHV1 /S/I/ /
BEMMO /S/I/ /	DSCRPT2 /S/M/ /	

## G2 CORRELATION AND REGRESSION ANALYSIS

BECTR /S/I/ /	CBNRHO /S/I/ /	RLFOTH /S/I/ /
BEMIRI /S/I/ /	CORCOV /S/M/ /	RLFOTW /S/I/ /
BEMIRO /S/I/ /	G3SLS /D/S/ /	RLGQMI /S/I/ /
BESRB /S/I/ /	LSQHTM /S/M/ /	RLGQMO /S/I/ /
BESRN /S/I/ /	LSQHTS /S/M/ /	RLINCF /S/I/ /
BMDP1R /M/C/ /	LSQSIT /S/M/ /	RLINPF /S/I/ /
BMDP2R /M/C/ /	NONLINE/D/S/ /	RLLAV /S/I/ /
BMDP3R /M/C/ /	NONPAR /D/S/ /	RLLMV /S/I/ /
BMDP4R /M/C/ /	OFRES1 /S/I/ /	RLMUL /S/I/ /
BMDP5R /M/C/ /	PARTIAL/D/S/ /	RLONE /S/I/ /
BMDP6R /M/C/ /	PEARSON/D/S/ /	RLOPDC /S/I/ /
BMD01R /M/B/ /	PLOT /D/S/ /	RLPOL /S/I/ /
BMD02D /M/B/ /	REGRESS/D/S/ /	RLPRDI /S/I/ /
BMD02R /M/B/ /	RLCOMP /S/I/ /	RLPRDO /S/I/ /
BMD03D /M/B/ /	RLDCQM /S/I/ /	RLRES /S/I/ /
BMD03R /M/B/ /	RLDCVA /S/I/ /	RLSEP /S/I/ /
BMD04R /M/B/ /	RLDCW /S/I/ /	RLSTP /S/I/ /
BMD05R /M/B/ /	RLDOPM /S/I/ /	RSMITZ /S/I/ /
BMD06R /M/B/ /	RLEAP /S/I/ /	SCATTER/D/S/ /
BMD07R /M/B/ /	RLFITI /S/I/ /	TETRACH/D/S/ /
BMD09M /M/B/ /	RLFITO /S/I/ /	
BMD12D /M/B/ /	RLFOR /S/I/ /	

G3 SEQUENTIAL ANALYSIS  
SURVIVA/D/S/ /

## G4 ANALYSIS OF VARIANCE

ABIBN /S/I/ /	ANESTU /S/I/ /	BMD04V /M/B/ /
ACRDAN /S/I/ /	ANOVA /D/S/ /	BMD05V /M/B/ /
ACTRST /S/I/ /	ANOVA1 /S/N*/ /	BMD06V /M/B/ /
AFACN /S/I/ /	ANOVA2 /S/N*/ /	BMD07V /M/B/ /
AFACT /S/I/ /	AORDR /S/I/ /	BMD08V /M/B/ /
AGBACP /S/I/ /	ARCBAN /S/I/ /	BMD09V /M/B/ /
AGLMOD /S/I/ /	ASNKMC /S/I/ /	BMD10V /M/B/ /
AGVACL /S/I/ /	BMDP1V /M/C/ /	BMD11V /M/B/ /
AGXPM /S/I/ /	BMDP2V /M/C/ /	BMD12V /M/B/ /
ALSQAN /S/I/ /	BMDP7D /M/C/ /	BRTLTT /S/M/ /
AMEANS /S/I/ /	BMD01V /M/B/ /	MANOVA /D/S/ /
ANCOV1 /S/I/ /	BMD02V /M/B/ /	NOVACOM /M/ /R/
ANESTE /S/I/ /	BMD03V /M/B/ /	ONEWAY /D/S/ /

## G5 TIME SERIES

BMD01T /M/B/ /	FTARPS /S/I/ /	FTMPS /S/I/ /
BMD02T /M/B/ /	FTAUTO /S/I/ /	FTMXL /S/I/ /
BMD03T /M/B/ /	FTCAST /S/I/ /	FTRDIF /S/I/ /
BMD04T /M/B/ /	FTCMP /S/I/ /	FTTRN /S/I/ /
BMD05T /M/B/ /	FTCROS /S/I/ /	FTWEIN /S/I/ /
FFTCC /S/I/ /	FTCRXY /S/I/ /	FTWENM /S/I/ /
FFTRC /S/I/ /	FTFPS /S/I/ /	FTWENX /S/I/ /
FFTSC /S/I/ /	FTFREQ /S/I/ /	HARM /S/M/ /
FFT2C /S/I/ /	FTGEN /S/I/ /	SPECTRA /D/S/ /
FFT3D /S/I/ /	FTKALM /S/I/ /	

## G6 SPECIAL FUNCTIONS (INCLUDES RANDOM NUMBERS AND PDF'S)

BETAR /S/M/ /	GTPBC /S/I/ /	PBINOM /S/M/ /
BMDP1S /M/C/ /	GTPKP /S/I/ /	PCHY /S/M/ /
BOXJENK /M/ /R/	GTPL /S/I/ /	PFDIST /S/M/ /
CHIDST /S/M/ /	GTPOK /S/I/ /	PGEOM /S/M/ /
CHIPRB /S/M/ /	GTPR /S/I/ /	PGMMA /S/M/ /
CHIRAB /S/M/ /	GTPST /S/I/ /	PHYPG /S/M/ /
CHIRUD /S/M/ /	GTRN /S/I/ /	PIBETA /S/M/ /
CHSQO /S/M/ /	GTRTN /S/I/ /	PIBIN /S/M/ /
CONRAY /S/M/ /	GTTT /S/I/ /	PICHI /S/M/ /
EXRAND /S/M/ /	IAOC /S/N/N/	PICHY /S/M/ /
GFIT /S/I/ /	IDAYWEK /S/N/N/	PIEXP /S/M/ /
GGAMR /S/I/ /	IRAND /S/M/ /	PIFDIS /S/M/ /
GGBN /S/I/ /	MDBETA /S/I/ /	PIGAMA /S/M/ /
GGBNR /S/I/ /	MDBETI /S/I/ /	PIGEO /S/M/ /
GGBTR /S/I/ /	MDBIN /S/I/ /	PIHYPG /S/M/ /
GGCAY /S/I/ /	MDBNOR /S/I/ /	PILGNM /S/M/ /
GGCHS /S/I/ /	MDCH /S/I/ /	PINCH /S/M/ /
GGDA /S/I/ /	MDCHI /S/I/ /	PINORM /S/M/ /
GGDT /S/I/ /	MDCHN /S/I/ /	PIPOIS /S/M/ /
GGEOT /S/I/ /	MDFD /S/I/ /	PIRAYL /S/M/ /
GGEXN /S/I/ /	MDFDRE /S/I/ /	PIS /S/M/ /
GGEXT /S/I/ /	MDFI /S/I/ /	PIT /S/M/ /
GGHPR /S/I/ /	MDGAM /S/I/ /	PITRNM /S/M/ /
GGMAR /S/I/ /	MDGC /S/I/ /	PIUNF /S/M/ /
GGMTN /S/I/ /	MDGCI /S/I/ /	PIUNFD /S/M/ /
GGNLG /S/I/ /	MDHYP /S/I/ /	PIWEBL /S/M/ /
GGNML /S/I/ /	MDNOR /S/I/ /	PLGNRM /S/M/ /
GGNPM /S/I/ /	MDNRIS /S/I/ /	PNBIN /S/M/ /
GGNQF /S/I/ /		PNORM /S/M/ /

## G6 SPECIAL FUNCTIONS (INCLUDES RANDOM NUMBERS AND PDF'S) (CONTINUED)

GGNSM /S/I/ /	MDSMR /S/I/ /	PORAND /S/M/ /
GGPON /S/I/ /	MDSTI /S/I/ /	PRAYL /S/M/ /
GGPOS /S/I/ /	MDTD /S/I/ /	PRBEXP /S/M/ /
GGSPH /S/I/ /	MDTN /S/I/ /	PRBUNF /S/M/ /
GGSTA /S/I/ /	MDTNF /S/I/ /	PTDIST /S/M/ /
GGTRA /S/I/ /	MDTPS /S/I/ /	PTRNRM /S/M/ /
GGUBFS /S/I/ /	MMPSI /S/I/ /	PUNFD /S/M/ /
GGUBS /S/I/ /	MSMRAT /S/I/ /	PWEBL /S/M/ /
GGUBT /S/I/ /	NDEFT /S/I/ /	RAND /S/M/ /
GGUD /S/I/ /	NDKER /S/I/ /	RANNUM /S/N/ *
GGUW /S/I/ /	NDMPLE /S/I/ /	RUN SAB /S/M/ /
GGVCR /S/I/ /	NONPAR /D/S/ /	RUNSUD /S/M/ /
GGWIB /S/I/ /	NRAND /S/M/ /	URAND /S/M/ /
GTDDU /S/I/ /	NRML /S/M/ /	USPC /S/I/ /
GTD2T /S/I/ /	NRMNO /S/M/ /	USPDF /S/I/ /
GTNOR /S/I/ /	PBETA /S/M/ /	XIRAND /S/M/ /

## G7 MULTIVARIATE ANALYSIS AND SCALE STATISTICS

AFACT /S/I/ /	BMD06S /M/B/ /	ODNORM /S/I/ /
BMDP1M /M/C/ /	BMD07M /M/B/ /	OF COEF /S/I/ /
BMDP2M /M/C/ /	BMD07S /M/B/ /	OF COMM /S/I/ /
BMDP3M /M/C/ /	BMD08M /M/B/ /	OF HARR /S/I/ /
BMDP4M /M/C/ /	BMD08S /M/B/ /	OF IMAG /S/I/ /
BMDP6M /M/C/ /	BMD09M /M/B/ /	OF PRI /S/I/ /
BMDP7M /M/C/ /	BMD10M /M/B/ /	OF PROT /S/I/ /
BMD01M /M/B/ /	CANCORR /D/S/ /	OF ROTA /S/I/ /
BMD02M /M/B/ /	DISCRIM /D/S/ /	OF SCHN /S/I/ /
BMD03M /M/B/ /	FACTOR /D/S/ /	OF SCOR /S/I/ /
BMD04M /M/B/ /	GUTTMAN /D/S/ /	OPRINC /S/I/ /
BMD04S /M/B/ /	JFACTOR /D/S/ /	OTMLNR /S/I/ /
BMD05M /M/B/ /	OCDIS /S/I/ /	RELIABI /D/S/ /
BMD05S /M/B/ /	OCLINK /S/I/ /	
BMD06M /M/B/ /	ODFISH /S/I/ /	

## G8 NON-PARAMETRIC METHODS AND STATISTICAL TESTS

BMDP1F /M/C/ /	NBQT /S/I/ /	NMKSF /S/I/ /
BMDP3S /M/C/ /	NBSDL /S/I/ /	NMKTS /S/I/ /
BMD02S /M/B/ /	NBSIGN /S/I/ /	NMRANK /S/I/ /
BMD08D /M/B/ /	NDKER /S/I/ /	NMTIE /S/I/ /
BMD09D /M/B/ /	NDMPLE /S/I/ /	NONPAR /D/S/ /
CROSSTA /D/S/ /	NHEXT /S/I/ /	NPAR /D/S/ /
NAK1 /S/I/ /	NHINC /S/I/ /	NRBHA /S/I/ /
NAWNRP /S/I/ /	NKS1 /S/I/ /	NRWMD /S/I/ /
NAWRPE /S/I/ /	NKS2 /S/I/ /	NRWRST /S/I/ /
NAWRPU /S/I/ /	NMCC /S/I/ /	SUMMARY /D/S/ /
NBCYC /S/I/ /	NMKEN /S/I/ /	

## G9 STATISTICAL INFERENCE

AGVACL /S/I/ /	BENSON /S/I/ /	CTRBYC /S/I/ /
ASNKMC /S/I/ /	BEPAT /S/I/ /	GTCN /S/I/ /
BEMNON /S/I/ /	BEPET /S/I/ /	OIND /S/I/ /
BEMSON /S/I/ /	CTPR /S/I/ /	

H1	LINEAR PROGRAMMING			
	ARRIBA /M/ /R/	ZX3LP /S/I/ /		
	ZX0LP /S/I/ /	ZX4LP /S/I/ /		
H3	TRANSPORTATION AND NETWORK CODES			
	PERTC /M/ /R/	PERTIME/M/ /R/		
H4	SIMULATION MODELING			
	GPSS /M/ /R/	SIMI15 /M/ /R/		
	MIMIC /M/ /R/	SIMI5 /M/ /R/		
I0	INPUT			
	FASTIN /S/N/*/			
I2	OCTAL			
	OFMTDE /S/N/N/	OFMTV /S/N/N/		
I3	DECIMAL			
	CRDTAB /S/N/*/	USRDM /S/I/ /		
	USCRDM /S/I/ /	USRDV /S/I/ /		
I4	BCD (HOLLERITH)			
	ICOM /S/N/*/	ICOMN /S/N/*/	IFMTV /S/N/N/	
I9	COMPOSITE			
	START /S/M/ /			
J1	BINARY			
	CV029 /M/U/U/	CV029 /P/P/P/		
J2	OCTAL			
	PRTFL /S/N/N/			
J3	DECIMAL			
	USLEAP /S/I/ /	USWBS /S/I/ /	USWFV /S/I/ /	
	USWBM /S/I/ /	USWFM /S/I/ /	USWSM /S/I/ /	
J4	BCD (HOLLERITH)			
	BANNER /M/U/U/	BANR6 /S/N/N/	LINE6 /S/N/N/	
	BANNERS/M/U/U/	COMQ /P/P/P/	LINE8 /P/P/P/	
	BANNERS/P/P/P/	COPYSF /M/ /R/	LINE8 /S/N/N/	
	BANNER3/M/U/U/	ICOM /S/N/*/	PM /P/P/P/	
	BANNER6/M/U/U/	ICOMN /S/N/*/	PRTIME /S/N/N/	
	BANR /S/N/N/	LINE6 /P/P/P/	REPORT /D/S/ /	
J5	PLOTTING			
	BMDP5D /M/C/ /	PLOTMY /S/N/*/	USHV1 /S/I/ /	
	BMDP6D /M/C/ /	PLOTPR /S/N/N/	USPC /S/I/ /	
	BMDP7D /M/C/ /	PLOTXY /S/N/*/	USPDF /S/I/ /	
	BMD05D /M/B/ /	SCATTER/D/S/ /	USPLT /S/I/ /	
	CALCOMP/S/ /R/	SCCALC /S/ /R/	USSLF /S/I/ /	
	CALC3D /P/P/P/	TEKTRNX/S/ /R/	USTREE /S/I/ /	
	DISSPLA/S/ /R/	USBOX /S/I/ /	XPLOT /S/M/ /	
	HSTGRM /S/M/ /	USHIST /S/I/ /	XYPLOT /S/M/ /	
	PLOT /D/S/ /	USHIUT /S/I/ /		



J9	COMPOSITE HEXDMP /M/U/U/	PRUDMP /M/U/U/	TAPDMP /M/U/U/
K1	EXTERNAL-TO-EXTERNAL COPYE /M/ /R/ COPYF /M/ /R/ COPYR /M/ /R/ COPYRE /M/U/U/ COPYRM /M/ /R/ COPYS /M/ /R/	COPYS /P/P/P/ COPYSEL /M/U/U/ COPYSF /M/ /R/ CVT360 /M/ /R/ DOCUMNT /M/U/U/ PFTRANS /M/ /R/	PFTRAN1 /P/P/P/ PROMNT /M/U/U/ RECADD1 /P/P/P/ RECDEL1 /P/P/P/ RECGET1 /P/P/P/ RECREP1 /P/P/P/
K2	INTERNAL-TO-INTERNAL (RELOCATION) CCOPY /S/I/ / CSWAP /S/I/ / DCOPY /S/I/ / DSWAP /S/I/ / GETRA /S/N/N/	MFETCH /S/N/N/ MOVECM /S/N/N/ MOVEIT /S/N/N/ MSET /S/N/N/ RCPA /S/N/N/	SAXPY /S/I/ / SCOPY /S/I/ / SSWAP /S/I/ / SWAP /S/N/N/
K3	DISK COPYL /M/ /R/ COPYLIB /M/U/U/ COPYLIB /P/P/P/ COPYN /M/ /R/ GETOBJ /M/U/U/ NEWNAME /M/U/U/	PROS2R /P/P/P/ PRUDMP /M/U/U/ SELDUMP /P/P/P/ TRANPAK /P/P/P/ UPDADD /P/P/P/ UPDDELE /P/P/P/	UPDGET /P/P/P/ UPDGETS /P/P/P/ UPDGETT /P/P/P/ UPDREPL /P/P/P/
K4	TAPE AUDPFT /M/U/U/ B7700S /P/P/P/ B7700U /P/P/P/	COPYBFR /M/ /R/ COPYBLK /P/P/P/ HEXDMP /M/U/U/	SELLOAD /P/P/P/ TAPDMP /M/U/U/
L0	EXECUTIVE ROUTINES ANYLIB /P/P/P/ ANYPRO /P/P/P/ ANYPROS /P/P/P/ BIGLOAD /P/P/P/ DISPOST /P/P/P/ LIBPRO /P/P/P/	LIBPROA /P/P/P/ LIBSET1 /P/P/P/ LIBSET2 /P/P/P/ MNSRDC /P/P/P/ MYPRO /P/P/P/ MYPROS /P/P/P/	NOGO /P/P/P/ PROGRAM /P/P/P/ SEGLD /P/P/P/ S2K260 /P/P/P/ UTILITY /P/P/P/
L2	COMPILING ALGOL /M/ /R/ BASIC /M/ /R/ COBOL /M/ /R/ FTN /M/ /R/ FTN5 /M/ /R/ MNF /M/ /*/	PASCAL /M/T/R/ PL1 /M/ /R/ RUN /M/ /R/ RUNBAS /P/P/P/ RUNFTN /P/P/P/ RUNMNF /P/P/P/	RUNPAS /P/P/P/ RUNSEQ /P/P/P/ RUNTS /P/P/P/ SNOBOL /M/ /R/
L3	MONITORING COMPASS /M/ /R/		
L4	PREPROCESSING RATFOR /M/ /*/	TIDY /M/ /R/	
L7	COMPUTER LANGUAGE TRANSLATORS		

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L7-M5

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F45 /M/ /R/

LCS /M/ /R/

## M0 DATA HANDLING

COMPAR /M/U/U/  
COMPSTR/S/N/N/EQU60 /S/N/N/  
MASKIT /S/N/N/

SWAP /S/N/N/

## M1 SORTING

ASORT /S/N/N/  
ASORTMV/S/N/N/  
AUDIT /P/P/P/  
AUDSORT/M/U/U/  
BMD14S /M/B/ /  
DEKSORT/M/U/U/  
HSTGRM /S/M/ /  
QSORT /S/N/N/QSORT1 /S/N/N/  
SORT /P/P/P/  
SORTCZ /P/P/P/  
SORTMRG/M/ /R/  
SSORT /S/N/N/  
SSORTF /S/N/N/  
SSORTI /S/N/N/  
SSORTL /S/N/N/VARORD /S/M/ /  
VECORD /S/M/ /  
VSRTA /S/I/ /  
VSRTM /S/I/ /  
VS RTP /S/I/ /  
VSRTT /S/I/ /  
VSRTU /S/I/ /

## M2 CONVERSION AND/OR SCALING

BMD09S /M/B/ /  
BMD12S /M/B/ /  
BMD13S /M/B/ /  
BR2CCL /P/P/P/  
CVT360 /M/ /R/  
CV029 /M/U/U/  
CV029 /P/P/P/  
DATCNV /S/N/N/DATFMT /S/N/N/  
GETHOUR/S/N/N/  
HEX3 /S/N/N/  
IHMS /S/N/N/  
IROMAN /S/N/N/  
ISEC /S/N/N/  
JGDATE /S/N/N/  
JULIAN /S/N/N/MONTH /S/N/N/  
NEWDAT /S/N/N/  
TIDY /M/ /R/  
UNHEX3 /S/N/N/  
WEKDAY /S/N/N/  
WRITE /M/ /R/

## M3 MERGING

SORTMRG/M/ /R/

## M4 CHARACTER MANIPULATION

ADJL /S/N/N/  
ADJR /S/N/N/  
ASCDC /M/U/U/  
ASHIFT /S/N/N/  
CENTER /S/N/N/  
CHFILL /S/N/N/  
CHNGSEQ/S/N/N/  
CONTRCT/S/N/N/  
COPYEXT/M/U/U/  
EXPAND /S/N/N/  
EXPRM /S/N/N/  
EXTBIT /S/N/N/  
EXTPRM /S/N/N/  
FBINRD /S/N/N/  
GETCHA /S/N/N/GETCHR /S/N/N/  
GETPRM /S/N/\*/  
IBUNP /S/N/N/  
IPAKLFT/S/N/N/  
ISTAPE /S/N/N/  
LBYT /S/N/N/  
LEFTADJ/S/N/N/  
MOVCHAR/S/N/N/  
MOVSTR /S/N/N/  
MXGET /S/N/N/  
PARGET /S/N/N/  
PUTCHA /S/N/N/  
PUTCHR /S/N/N/  
REPLAC /S/N/N/  
REPLACM/S/N/N/REPLHI /S/N/N/  
REPLLO /S/N/N/  
REPLNE /S/N/N/  
SBYT /S/N/N/  
SEMICO /S/N/N/  
SETREW /S/N/N/  
SHIFTA /S/N/N/  
SKWEZL /S/N/N/  
SKWEZR /S/N/N/  
TRAILBZ/S/N/N/  
VALDAT /S/N/N/  
VFILL /S/N/N/  
ZBLANK /S/N/N/  
ZEROFL /S/N/N/  
ZEROS /S/N/N/

## M5 SEARCHING, SEEKING, LOCATING

AMAXE /S/N/N/  
AMINE /S/N/N/  
FINDC /S/N/N/  
FINDW /S/N/N/  
FINDWRD/S/N/N/  
GETCHA /S/N/N/  
GETCHR /S/N/N/GETLIB /S/N/N/  
ICAMAX /S/I/ /  
IDAMAX /S/I/ /  
IDIGIT /S/N/N/  
IFINDCH/S/N/N/  
ISAMAX /S/I/ /  
LASTC /S/N/N/LASTCH /S/N/N/  
LASTWRD/S/N/N/  
MAXE /S/N/N/  
MINE /S/N/N/  
NFILLT /S/N/N/  
NUMVAR /S/N/N/  
VALIDT /S/N/N/

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M6-Q0

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## M6 REPORT GENERATORS

PR2UP /M/U/U/

QU /M/ /R/

SCORE /M/ /R/

## N0 DEBUGGING

ALTIME /S/N/N/

MONERR /S/F/ /

ELTIME /S/N/N/

PRTIME /S/N/N/

## N2 DUMPING

DMPA /S/N/N/

DUMPCPA/S/N/N/

RECOVRD/S/N/N/

DMPCPA /S/N/N/

DUMPFL /S/N/N/

TAPDMP /M/U/U/

DMPFIL /M/U/U/

HEXDMP /M/U/U/

DUMPA /S/N/N/

PRUDMP /M/U/U/

## O1 OFF-LINE EQUIPMENT (LISTERS, REPRODUCERS, ETC.)

CARDS /M/U/U/

LIST /P/P/P/

PROALL /P/P/P/

CARDS2 /M/U/U/

LISTCMP/M/U/U/

PRODOC /P/P/P/

COPYEXT/M/U/U/

LISTEOI/M/U/U/

PROLIST/P/P/P/

COPYRE /M/U/U/

LISTN /M/U/U/

PR2UP /M/U/U/

COPYSEL/M/U/U/

LISTZ /M/U/U/

RECDOC /P/P/P/

CV029 /M/U/U/

LIST1 /M/U/U/

TIDBITS/P/P/P/

CV029 /P/P/P/

LIST2 /M/U/U/

UPDDOC /P/P/P/

DOCDATE/P/P/P/

LIST3 /M/U/U/

UPDLIST/P/P/P/

DOCDOC /P/P/P/

LIST4 /M/U/U/

WARNING/S/N/N/

FRAME /M/U/U/

MANUAL /M/U/U/

WRITE /M/ /R/

GETREV /M/U/U/

MANUAL /P/P/P/

LINERL /M/U/U/

PAGEPRT/M/U/U/

## P0 DIAGNOSTICS (HARDWARE MALFUNCTION)

UERTST /S/I/ /

## Q0 SERVICE OR HOUSEKEEPING, PROGRAMMING AIDS

AC /S/N/N/

GETFIT /S/N/N/

OVLNAME/S/N/N/

ALTIME /S/N/N/

GETLFNS/S/N/N/

PFRC /S/N/N/

AUDIT /P/P/P/

GETLGO /S/N/N/

PRTFL /S/N/N/

AUDPFT /M/U/U/

GETLIB /S/N/N/

PTIM /M/U/U/

BANNER /M/U/U/

GETPROD/P/P/P/

REDUCE /S/N/N/

BANNERS/M/U/U/

GODROP /S/N/N/

ROUTERC/S/N/N/

BANNERS/P/P/P/

HERE /S/N/N/

SEND /P/P/P/

BANNER3/M/U/U/

IBL /S/N/N/

SKPSTAT/S/ / /

BANNER6/M/U/U/

IDID /S/N/N/

S2KRNM /M/U/U/

BANR /S/N/N/

ISITCNF/S/N/N/

TIMLEFT/S/N/N/

BANR6 /S/N/N/

JOBNAME/S/N/N/

UHELP /S/I/ /

BDT /P/P/P/

JOBORG /S/N/N/

UHELP1 /S/I/ /

BUFSIZE/S/N/N/

JOBTIME/M/U/U/

UHELP2 /S/I/ /

CALCIBL/M/U/U/

LINER /M/U/U/

UHELP3 /S/I/ /

CBLFMT /M/U/U/

LINERL /M/U/U/

UHELP4 /S/I/ /

COMQ /P/P/P/

MACHINE/S/ / /

WHATLIB/M/U/U/

DFDATIM/M/U/U/

MEMUSED/S/N/N/

WHATLIB/P/P/P/

EDIT /M/ /R/

MFRAME /S/N/N/

WHICHMF/M/U/U/

ELTIME /S/N/N/

MFX /P/P/P/

WHICHOS/M/U/U/

EDFAD /M/U/U/

NORERUN/P/P/P/

ZPFPUT /S/N/N/

FRAME /M/U/U/

NUMEXEC/S/N/N/

ZRTPUT /S/N/N/

FTNRFL /S/N/N/

NUMVAR /S/N/N/

Q1 CLEAR/RESET  
     UERSSET /S/I/ /      UGETIO /S/I/ /

Q3 FILE MANIPULATION

ANYLIB /P/P/P/	LIBSET1/P/P/P/	SEGLD /P/P/P/
ANYPRO /P/P/P/	LIBSET2/P/P/P/	SKPFIL /S/ / /
ANYPROS/P/P/P/	MNSRDC /P/P/P/	S2K260 /P/P/P/
BIGLOAD/P/P/P/	MYPRO /P/P/P/	UNLOAD /S/N/N/
CLUNLD /S/N/N/	MYPROS /P/P/P/	UPDLIST/P/P/P/
DISPOST/P/P/P/	NOGO /P/P/P/	UTILITY/P/P/P/
EOI /M/U/U/	PROGRAM/P/P/P/	ZPFUNC /S/N/N/
LIBPRO /P/P/P/	REQUEST/S/N/N/	ZSYSEQ /S/N/N/
LIBPROA/P/P/P/	ROUTE /S/N/N/	

Q4 INTERNAL HOUSEKEEPING, SAVE, RESTORE, ETC.

ADDEXT /P/P/P/	PFRSTOR/P/P/P/	PURGEN /P/P/P/
DBUTIL /M/ /R/	PHC /P/P/P/	RENAMAC/P/P/P/
PAC /P/P/P/	PLC /P/P/P/	SELDUMP/P/P/P/
PAHC /P/P/P/	PRTIME /S/N/N/	SELLOAD/P/P/P/
PALC /P/P/P/	PURGALL/P/P/P/	

Q5 REPORT GENERATOR SUBROUTINES  
     REPORT /D/S/ /

Q6 PROGRAM DOCUMENTATION: FLOW CHARTS, DOCUMENT STANDARDIZATION

DOC /M/U/U/	DOCLIST/P/P/P/	MTDOC /M/U/U/
DOCADD /P/P/P/	DOCREPL/P/P/P/	PFDOC /M/U/U/
DOCDAT /M/U/U/	DOCTAPE/P/P/P/	PGMTAPE/P/P/P/
DOCDELE/P/P/P/	DOCUMNT/M/U/U/	PROGDOC/M/U/U/
DOCFILE/P/P/P/	EXECARD/M/U/U/	PURPOSE/M/U/U/
DOCGET /P/P/P/	LGOTREE/P/P/P/	TAPLIST/M/U/U/
DOCIT /M/U/U/	MANYDOC/M/U/U/	UNDOCIT/M/U/U/

Q7 PROGRAM LIBRARY UTILITIES

BINDEX /M/U/U/	LISTCMP/M/U/U/	SORTUP /M/U/U/
COPYL /M/ /R/	PROADD /P/P/P/	UPDADD /P/P/P/
COPYLIB/P/P/P/	PRODELE/P/P/P/	UPDATE /M/ /R/
COPYN /M/ /R/	PROGET /P/P/P/	UPDDELE/P/P/P/
DECK /M/U/U/	PROHDR /P/P/P/	UPDGET /P/P/P/
DECKLST/M/U/U/	PROMNT /M/U/U/	UPDGETS/P/P/P/
DEKSORT/M/U/U/	PRONAM /P/P/P/	UPDGETT/P/P/P/
EDITLIB/M/ /R/	PROREPL/P/P/P/	UPDREPL/P/P/P/
ITEMIZE/M/ /R/	PROS2R /P/P/P/	
LISTBIN/M/U/U/	REDECK /M/U/U/	

R1 FORMAL LOGIC  
     COUPLE /S/N/N/

R3 LIST AND STRING PROCESSING  
     PROSE /M/ /R/      SNOBOL /M/ /R/

R4 TEXT EDITING  
     EDITOR /M/ /R/      NETED /M/ /\*/      RNF /M/ /\*/

## S0 INFORMATION RETRIEVAL

ACCTRPT/M/ /R/	DOCUMNT/M/U/U/	PURPOSE/M/U/U/
ADPCOST/M/ /R/	EXECARD/M/U/U/	QQ /M/ /R/
AUDIT /P/P/P/	GETREV /M/U/U/	QU /M/ /R/
AUDPFT /M/U/U/	GRIPE /P/P/P/	RIQS /M/ /R/
AUDSORT/M/U/U/	MANUAL /M/U/U/	SHARP /M/ /R/
CCNOTE /P/P/P/	MANYDOC/M/U/U/	S2K260 /M/ /R/
DBUTIL /M/ /R/	MARS /M/ /R/	TAPLIST/M/U/U/
DDL /M/ /R/	PAGEPRT/M/U/U/	VENUS /M/ /R/
DMS170 /M/ /R/	PROGDOC/M/U/U/	VENUS /P/P/P/
DOCDAT /M/U/U/	PROMNT /M/U/U/	

## T4 ENGINEERING

ARDCFT /S/N/*/	ECAP /M/ /R/	NASTRAN/M/ /R/
CIVCO /M/ /R/	ELBOW /M/ /R/	STRESS /M/ /R/

## T6 MANUFACTURING (NON-DATA) PROCESSING AND PROCESS CONTROL

APT /M/ /R/

## V1 RANDOM NUMBER GENERATORS

EXRAND /S/M/ /	NRMNO /S/M/ /	RNDMIZ /S/N/N/
IRAND /S/M/ /	PORAND /S/M/ /	URAND /S/M/ /
NRAND /S/M/ /	RAND /S/M/ /	XIRAND /S/M/ /
NRML /S/M/ /	RANNU /S/N/*/	

## X5 ANALYSIS (TIME-SERIES ANALYSIS)

BOXJENK/M/ /R/	SPECTRA/D/S/ /	SURVIVA/D/S/ /
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## Z0 ALL OTHERS

PASCLIB/S/T/R/	PTOOLS /M/T/R/	SSP /S/ /R/
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## \*\*\*\*\* PROGRAMS \*\*\*\*\*

THE COMPUTER CENTER CURRENTLY MAINTAINS FOUR LIBRARIES OF MAIN PROGRAMS IN ABSOLUTE FORM:

- 1) BIMED - SOME OF THE BMD BIOMEDICAL STATISTICAL PROGRAMS
- 2) BIMEDP - SOME OF THE BMDP BIOMEDICAL STATISTICAL PROGRAMS
- 3) MNSRDC - LOCALLY WRITTEN AND/OR SUPPORTED SCIENTIFIC PROGRAMS
- 4) UTILITY - LOCALLY WRITTEN AND/OR SUPPORTED UTILITIES

THERE ARE ALSO SOME MAIN PROGRAMS, INCLUDING SPSS AND CVT360, WHICH ARE MAINTAINED IN SEPARATE FILES.

## \*\*\* BIMED \*\*\*

THE FOLLOWING IS A LIST OF THE UCLA BIOMEDICAL STATISTICAL PROGRAMS. THOSE WITH AN ASTERISK (\*) ARE AVAILABLE IN LIBRARY 'BIMED'. SOME OF THE OTHERS MAY BE ADDED IF REQUESTED.

REFERENCE: "BMD BIOMEDICAL COMPUTER PROGRAMS", W. J. DIXON. EDITOR, UNIVERSITY OF CALIFORNIA PRESS, BERKELEY, 1973.

BMD01D SIMPLE DATA DESCRIPTION  
BMD02D CORRELATION WITH TRANSGENERATION  
BMD03D \* CORRELATION WITH ITEM DELETION  
BMD04D ALPHANUMERIC FREQUENCY COUNT  
BMD05D \* GENERAL PLOT INCLUDING HISTOGRAM  
BMD06D DESCRIPTION OF STRATA  
BMD07D DESCRIPTION OF STRATA WITH HISTOGRAMS  
BMD08D CROSS-TABULATION WITH VARIABLE STACKING  
BMD09D CROSS-TABULATION, INCOMPLETE DATA  
BMD10D DATA PATTERNS FOR DICHOTOMIES  
BMD11D DATA PATTERNS FOR POLYCHOTOMIES  
BMD12D ASYMMETRIC CORRELATION WITH MISSING DATA  
BMD13D T PROGRAM

BMD01M PRINCIPAL COMPONENT ANALYSIS  
BMD02M REGRESSION ON PRINCIPAL COMPONENTS  
BMD03M FACTOR ANALYSIS  
BMD04M DISCRIMINANT ANALYSIS FOR TWO GROUPS  
BMD05M \* DISCRIMINANT ANALYSIS FOR SEVERAL GROUPS  
BMD06M CANONICAL ANALYSIS  
BMD07M STEPWISE DISCRIMINANT ANALYSIS  
BMD08M FACTOR ANALYSIS  
BMD09M CANONICAL CORRELATION ANALYSIS  
BMD10M IDENTIFICATION OF OUTLIERS

BMD01R     SIMPLE LINEAR REGRESSION  
BMD02R     STEPWISE REGRESSION  
BMD03R \*    MULTIPLE REGRESSION WITH CASE COMBINATIONS  
BMD04R \*    PERIODIC REGRESSION AND HARMONIC ANALYSIS  
BMD05R \*    POLYNOMIAL REGRESSION  
BMD06R     ASYMPTOTIC REGRESSION  
BMD07R \*    NON-LINEAR LEAST SQUARES

BMD01S     LIFE TABLE AND SURVIVAL RATE  
BMD02S     CONTINGENCY TABLE ANALYSIS  
BMD03S     BIOLOGICAL ASSAY: PROBIT ANALYSIS  
BMD04S     GUTTMAN SCALE PREPROCESSOR  
BMD05S     GUTTMAN SCALE # 1  
BMD06S     GUTTMAN SCALE # 2, PART 1  
BMD07S     GUTTMAN SCALE # 2, PART 2  
BMD08S     GUTTMAN SCALE # 2, PART 3  
BMD09S     TRANSGENERATION  
BMD10S     TRANSPOSITION OF LARGE MATRICES  
BMD11S     LIFE TABLE AND SURVIVAL RATE (NO. 2)  
BMD12S     OPEN-ENDED TRANSGENERATION  
BMD13S     MULTIPASS TRANSGENERATION  
BMD14S     GENERALIZED SORTING ROUTINE

BMD01T     AMPLITUDE AND PHASE ANALYSIS  
BMD02T     AUTOCOVARANCE AND POWER SPECTRAL ANALYSIS  
BMD03T     TIME SERIES SPECTRUM ESTIMATION  
BMD04T     MULTIPLE TIME SERIES SPECTRAL ANALYSIS  
BMD05T     TIME-LOCKED AVERAGING

BMD01V     ANALYSIS OF VARIANCE FOR ONE-WAY DESIGN  
BMD02V     ANALYSIS OF VARIANCE FOR FACTORIAL DESIGN  
BMD03V     ANALYSIS OF COVARIANCE FOR FACTORIAL DESIGN  
BMD04V     ANALYSIS OF COVARIANCE WITH MULTIPLE COVARIATES  
BMD05V     GENERAL LINEAR HYPOTHESIS  
BMD06V     GENERAL LINEAR HYPOTHESIS WITH CONTRASTS  
BMD07V     MULTIPLE RANGE TESTS  
BMD08V     ANALYSIS OF VARIANCE  
BMD09V     ANALYSIS OF COVARIANCE  
BMD10V     GENERAL LINEAR HYPOTHESIS (NO. 2)  
BMD11V     MULTIVARIATE GENERAL LINEAR HYPOTHESIS  
BMD12V \*    MULTIVARIATE ANALYSIS OF VARIANCE AND COVARIANCE

## \*\*\* BIMEDP \*\*\*

THE FOLLOWING IS A LIST OF THE UCLA BIOMEDICAL STATISTICAL PROGRAMS (P-SERIES). ALL ARE AVAILABLE IN LIBRARY 'BIMEDP'.

REFERENCE: "BMDP BIOMEDICAL COMPUTER PROGRAMS", W. J. DIXON, EDITOR, UNIVERSITY OF CALIFORNIA PRESS, BERKELEY, 1975.

-OR-

"BMDP-77 BIOMEDICAL COMPUTER PROGRAMS P-SERIES", W. J. DIXON, EDITOR, UNIVERSITY OF CALIFORNIA PRESS, BERKELEY, 1975.

BMDP1D	SIMPLE DATA DESCRIPTION
BMDP2D	FREQUENCY COUNT ROUTINE
BMDP3D	T TEST AND T-SQUARED ROUTINE
BMDP4D	ALPHANUMERIC FREQUENCY COUNT ROUTINE
BMDP5D	UNIVARIATE PLOTTING
BMDP6D	BIVARIATE PLOTTING
BMDP7D	DESCRIPTION OF STRATA WITH HISTOGRAMS AND ANALYSIS OF VARIANCE
BMDP8D	MISSING VALUE CORRELATION
BMDP9D	MULTIDIMENSIONAL DATA DESCRIPTION
BMDP1F	TWO-WAY CONTINGENCY TABLES
BMDP1M	CLUSTER ANALYSIS ON VARIABLES
BMDP2M	CLUSTER ANALYSIS ON CASES
BMDP3M	BLOCK CLUSTERING
BMDP4M	FACTOR ANALYSIS
BMDP6M	CANONICAL CORRELATION ANALYSIS
BMDP7M	STEPWISE DISCRIMINANT ANALYSIS
BMDP1R	MULTIPLE LINEAR REGRESSION
BMDP2R	STEPWISE REGRESSION
BMDP3R	NONLINEAR REGRESSION
BMDP4R	REGRESSION ON PRINCIPAL COMPONENTS
BMDP5R	POLYNOMIAL REGRESSION
BMDP6R	PARTIAL CORRELATION AND MULTIVARIATE REGRESSION
BMDP1S	MULTIPASS TRANSFORMATION
BMDP3S	NONPARAMETRIC STATISTICS
BMDP1V	ONE-WAY ANALYSIS OF VARIANCE AND COVARIANCE
BMDP2V	ANALYSIS OF VARIANCE AND COVARIANCE, INCLUDING REPEATED MEASURES



## \*\*\* MNSRDC \*\*\*

THE COMPUTER CENTER MAINTAINS SOME LOCALLY WRITTEN AND/OR SUPPORTED SCIENTIFIC PROGRAMS IN THE PUBLIC ACCESS LIBRARY CALLED 'MNSRDC'. PROGRAMS IN THE LIBRARY MAY BE EXECUTED IN ONE OF THE FOLLOWING WAYS:

A) ATTACH,MNSRDC.  
LIBRARY,MNSRDC. OR LDSET,LIB=MNSRDC.  
PROG,<PARAMETERS>. WHERE PROG IS THE DESIRED PROGRAM

B) BEGIN,MNSRDC,,PROG,<PARAMETERS>.

REFERENCE: CLIB/M. BECAUSE THERE ONLY TWO ROUTINES IN MNSRDC, ONLY A COMPUTER COPY OF THE MANUAL IS AVAILABLE. WHEN THERE IS A SUFFICIENT NUMBER OF ROUTINES IN MNSRDC, CLIB/M WILL BE PUBLISHED FORMALLY. ADDITIONS TO THE LIBRARY ARE WELCOME.

LIBRARY 'MNSRDC' CONTAINS THE FOLLOWING PROGRAMS:

PLRG	POLYNOMIAL REGRESSION (IBM SSP SAMPLE PROGRAM MODIFIED)
POLYMUL	ROOTS OF A POLYNOMIAL WITH COMPLEX COEFFICIENTS BY MULLER'S METHOD

## \*\*\* SPSS \*\*\*

STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES (SPSS) IS AN OPEN-ENDED INTEGRATED SYSTEM OF STATISTICAL PROGRAMS EMBEDDED IN A SINGLE CONTROL PROGRAM. THE CDC 6000 VERSION WAS OBTAINED FROM NORTHWESTERN UNIVERSITY AND IS MAINTAINED BY ONE OF OUR CUSTOMERS (THE CONSTRUCTION ENGINEERING RESEARCH LABORATORY (CERL), COMPUTER SERVICES BRANCH). SPSS IS A BATCH SYSTEM WRITTEN MOSTLY IN FORTRAN. THIS PACKAGE (VERSION 8) IS MORE VERSATILE THAN THE BIMED ROUTINES (PAGE 2-1), SINCE MANY DIFFERENT STATISTICS CAN BE PERFORMED ON THE SAME DATA IN ONE RUN.

REFERENCES: "SPSS, SECOND EDITION", NIE, HULL, JENKINS, STEINBRENNER AND BENT, MCGRAW-HILL, 1975.

"SPSS PRIMER", KLECKA, NIE AND HULL, MCGRAW-HILL, 1975.

"SPSS UPDATE", HULL, NIE, MCGRAW-HILL, INC., 1979.

THE FOLLOWING DOCUMENTS MAY BE PRINTED:

BEGIN,DOCGET,,SPSS,,ALL,OUTPUT.	VERSION 8/7 DIFFS (13 PAGES)
BEGIN,DOCGET,,SPSSV8,,ALL,OUTPUT.	MCGRAW-HILL UPDATE (67 PAGES)

'SPSS' CONTAINS THE FOLLOWING DATA-CARD-CALLABLE PROCEDURES:

AGGREGATE	DESCRIPTIVE GROUP STATISTICS FOR SPECIFIED VARIABLES WRITTEN TO RAW OUTPUT FILE
ANOVA	ONE- TO FIVE-WAY ANALYSIS OF VARIANCE AND COVARIANCE FOR FACTORIAL DESIGNS
BREAKDOWN	DESCRIPTIVE STATISTICS ON SUBGROUPS
CANCORR	CANONICAL CORRELATION ANALYSIS AND TESTS OF STATISTICAL SIGNIFICANCE
CONDESCRIPTIVE	DESCRIPTIVE STATISTICS FOR CONTINUOUS (UNGROUPED) VARIABLES
CROSSTABS	2-WAY TO N-WAY JOINT FREQUENCY DISTRIBUTION, CONTINGENCY TABLES AND RELATED MEASURES OF ASSOCIATION
DISCRIMINANT	MULTIPLE DISCRIMINANT ANALYSIS IN STEPWISE OR DIRECT MODE
FACTOR	FACTOR ANALYSIS BY ONE OF FIVE DIFFERENT METHODS
FREQUENCIES	ONE-WAY FREQUENCY DISTRIBUTIONS WITH DESCRIPTIVE STATISTICS
GUTTMAN	UP TO 50 SEPARATE GUTTMAN SCALES BY VARIANT OF GOOD ENOUGH TECHNIQUE

G3SLS	GENERALIZED AND 3-STAGE LEAST SQUARES ESTIMATES OF THE PARAMETERS OF A SYSTEM OF SIMULTANEOUS STOCHASTIC EQUATIONS
JFACTOR	JORESKOG FACTOR ANALYSIS FOR GENERALIZED LEAST SQUARES, MAXIMUM LIKELIHOOD, AND UNWEIGHTED LEAST SQUARES
MANOVA	MULTIVARIATE ANALYSIS OF VARIANCE AND COVARIANCE WITH UNEQUAL CELL FREQUENCIES
MULT RESPONSE	FREQUENCY AND CROSSTABULATION TABLES FOR MULTIPLE RESPONSE VARIABLES
NONLINEAR	NONLINEAR REGRESSION BY MINIMIZING SUMS OF SQUARES
NONPAR CORR	SPEARMAN AND/OR KENDALL RANK-ORDER CORRELATION COEFFICIENTS AND LEVEL OF SIGNIFICANCE
NPAR TESTS	13 NONPARAMETRIC STATISTICAL TESTS
ONEWAY	ONE-WAY ANALYSIS OF VARIANCE WITH RANGE TESTS
PARTIAL CORR	UP TO 25 SETS OF PARTIAL CORRELATIONS OF ANY ORDER OR COMBINATION - LEAST SQUARES REGRESSION IN MULTIPLE OR STEPWISE MODE
PEARSON CORR	PEARSON PRODUCT-MOMENT (ZERO-LEVEL) CORRELATION COEFFICIENTS AND LEVEL OF SIGNIFICANCE
PLOT	BIVARIATE PLOTS FOR CALCOMP
REGRESSION	MULTIPLE REGRESSION ANALYSIS BY FORWARD INCLUSION, BACKWARD ELIMINATION OR STEPWISE SOLUTION METHOD
RELIABILITY	COEFFICIENTS OF RELIABILITY AND OTHER SUMMARY STATISTICS FOR EVALUATING MULTIPLE ITEM SCALES
REPORT	FLEXIBLE REPORT GENERATOR WITH SUMMARY AND COMPOSITE STATISTICS
SCATTERGRAM	SCATTER DIAGRAM OF DATA POINTS AND SIMPLE REGRESSION
SPECTRAL	SPECTRAL ANALYSIS USING FOURIER METHODS TO REPRESENT A TIME SERIES
SUMMARY TABLES	TABLES (PERCENTAGES AND OPTIONAL CELL COUNTS) WHICH SUMMARIZE RELATIONSHIPS BETWEEN INDEPENDENT VARIABLE AND A NUMBER OF DICHOTOMOUS DEPENDENT VARIABLES
SURVIVAL	SURVIVAL ANALYSIS AND LIFE EXPECTANCIES - EVALUATE TIME INTERVAL BETWEEN STARTING AND TERMINAL EVENTS
TETRACHORIC	TETRACHORIC CORRELATION COEFFICIENTS BETWEEN DICHOTOMOUS VARIABLES
T-TEST	STUDENT'S T AND PROBABILITY LEVELS TESTS ON SAMPLE MEANS

FEB 1981

CDC 6000

UTILITY

PAGE 2-7

<RESERVED FOR FUTURE EXPANSION OF SPSS>

## \*\*\* UTILITY \*\*\*

THE COMPUTER CENTER MAINTAINS SOME LOCALLY WRITTEN AND/OR SUPPORTED UTILITIES IN THE PUBLIC ACCESS LIBRARY CALLED 'UTILITY'. PROGRAMS IN THIS LIBRARY MAY BE EXECUTED IN ONE OF THE FOLLOWING WAYS:

A) ATTACH,UTILITY.  
LIBRARY,UTILITY. OR LDSET,LIB=UTILITY.  
PROG,<PARAMETERS>. WHERE PROG IS THE DESIRED PROGRAM

B) BEGIN,UTILITY,,PROG,<PARAMETERS>.

REFERENCES: ALL OF THESE PROGRAMS ARE DOCUMENTED IN CLIB/U, WHICH MAY BE OBTAINED FROM USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCGET' (SEE PAGE 1-2).

## LIBRARY 'UTILITY' CONTAINS THE FOLLOWING PROGRAMS:

ASCDC	CONVERT 7-BIT ASCII FILE TO 6-BIT CDC AND VICE VERSA
AUDPFT	PRODUCE MINI-AUDIT OF USER PFDUMP TAPES CREATED BY SELDUMP OR PRIVATE PACK PFDUMP
AUDSORT	SORT OUTPUT FROM USER AUDIT
BANNER	PRINT A BANNER (PAGE)
BANNERS	PRINT 1 TO 8 BANNERS ON ONE PAGE
BANNER3	PRINT 3 BANNERS ON ONE PAGE (LETTERS ARE 10 LINES HIGH)
BANNER6	PRINT 1-6 BANNERS ON ONE PAGE (LETTERS ARE 6 LINES HIGH)
BINDEX	GIVE LIST AND SORTED LIST OF OUTPUT OF EDITLIB 'LISTLIB' AND 'CONTENT' DIRECTIVES
CALCIBL	CALCULATE BEST BLOCK LENGTHS (I.E., MINIMUM TIME REQUIRED FOR RANDOM ACCESS AND MINIMUM BUFFER SIZE) FOR INDEX SEQUENTIAL FILE
CARDS	REPRODUCE A BCD DECK WITH MODIFICATIONS. (FIELDS MAY BE MOVED, DELETED, INTERCHANGED, GANG PUNCHED AND/OR SEQUENCED)
CARDS2	REPRODUCE A BCD DECK WITH MODIFICATIONS. (FIELDS MAY BE COPIED, MOVED, DELETED, INTERCHANGED, GANG PUNCHED AND/OR SEQUENCED.)
CBLFMT	REFORMAT A COBOL SOURCE PROGRAM TO ENHANCE ITS READABILITY, THEREBY MAKING IT EASIER TO UNDERSTAND AND MODIFY
COMPAR	COMPARE TWO TEXT FILES AND REPORT ANY DIFFERENCES

COPYEXT COPY UNIT RECORDS (ZERO BYTE TERMINATED) EXTRACTING SPECIFIED COLUMNS AND OPTIONALLY MOVING THEM AND OPTIONALLY ADD EDITOR SEQUENCING

COPYLIB FROM AN EDITLIB LISTLIB LISTING, CREATE SORTED (OR UNSORTED) DIRECTIVES TO COPY AN EDITLIB USER LIBRARY

COPYRE COPY AND REARRANGE FILE OF ZERO BYTE TERMINATED RECORDS (150 CHARACTERS MAXIMUM PER RECORD; FILE PROCESSED IN CORE)

COPYSEL COPY AND REARRANGE FILE OF ZERO BYTE TERMINATED RECORDS (150 CHARACTERS MAXIMUM PER RECORD; FILE PROCESSED DIRECTLY)

CV029 CONVERT TO 029 PUNCH CODE

DECK LIST UPDATE 'SOURCE' FILE DECK/COMDECK NAMES, SEQUENCE NUMBER AND NUMBER OF CARDS

DECKLST LIST UPDATE 'SOURCE' FILE DECK/COMDECK NAMES, SEQUENCE NUMBER, NUMBER OF CARDS, NUMBER OF LINES AND PAGES (IF COLUMN 1 CARRIAGE CONTROL IS USED). (LIST CONTENTS OF A DOCUMENTATION FILE)

DEKSORT SORT IDENT AND DECK LISTINGS FROM UPDATE OUTPUT FILE

DFDATIM PUT DATE/TIME INTO DAYFILE

DMPFIL DUMP FIRST N WORDS OF EACH LOGICAL RECORD IN M FILES

DOC PREPARE (SUB)PROGRAM AND CATALOGUED PROCEDURE DOCUMENTATION

DOCDAT LIST DOCUMENT NAMES, DATES AND PAGE NUMBERS

DOCIT ADD PAGING TO ONE OR MORE DOCUMENTS

DOCUMNT MAINTAIN A FILE OF DOCUMENTS

EOFAD ADD OR DELETE EOF'S TO/FROM A FILE (THRU EOI)

EOI POSITION A FILE AT END-OF-INFORMATION (EOI)

EXECARD EXTRACT EXECUTE CARD PARAMETER/SUBPROGRAM USAGE/PROCEDURE USAGE INFORMATION FROM DOCUMENTATION FILES (WHICH WERE PREPARED IN THE FORMAT GENERATED BY PROGRAM 'DOC')

FRAME PRINT A FRAME FOR LINING UP PRINTOUTS

GETOBJ EXTRACT ONE OBJECT MODULE FROM A SEQUENTIAL OBJECT FILE OR AN EDITLIB USER LIBRARY

GETREV EXTRACT ALL PAGES FROM A MANUAL WHICH WERE MODIFIED AFTER USER-SPECIFIED DATE

HEXDMP DUMP 9-TRACK TAPE IN HEXADECIMAL FORMAT

JOBTIME PUT JOB CP EXECUTION TIME TO THIS POINT INTO DAYFILE

LINER COUNT LINES AND PAGES OF A FILE HAVING FIRST CHARACTER CARRIAGE CONTROL

LINERL LIST A DOCUMENT (CARRIAGE CONTROL IN COLUMN 1, ZERO BYTE TERMINATED RECORDS) WITH RECORD COUNT AND COUNT OF LINES ON EACH PAGE. LIST THRU END-OF-INFORMATION.

LISTBIN LIST BINARY MODULES AND PROCEDURES IN ONE OR MORE FILES

LISTCMP LIST AN UPDATE COMPILE FILE, EACH DECK BEGINNING ON A NEW PAGE WITH A BANNER PAGE PRECEDING IT

LISTEOI LIST A FILE INSERTING \*EOR, \*EOF, \*EOI WHERE APPROPRIATE

LISTN NUMBERED LIST OF ONE FILE OF ZERO-BYTE TERMINATED RECORDS

LISTZ LIST ZERO-BYTE TERMINATED RECORDS WITH RECORD NUMBER AND LENGTHS (USER MAY SPECIFY MAXIMUM NUMBER OF CHARACTERS TO READ (DEFAULT: 140) AND PRINT (DEFAULT: 110))

LIST1 LIST (CENTERED) ONE COPY OF CARDS (UP TO 90 CHARACTERS) HAVING CARRIAGE CONTROL IN COLUMN 1. OPTIONALLY PRINT CARD, PAGE AND LINE COUNTS AND LINE LENGTHS.

LIST2 SINGLE/DOUBLE SPACE LISTING, 6 OR 8 LINES PER INCH, WITH OPTIONAL SKIP OVER PERFORATION AT BOTTOM OF PAGE (FIRST 120 CHARACTERS)

LIST3 LIST FIRST (UP TO 90-CHARACTER, ZERO BYTE TERMINATED) RECORD IN EACH LOGICAL RECORD THROUGH EOI

LIST4 LIST UNIT RECORDS, THRU EOI, WHICH HAVE '1' IN COLUMN 1

MANUAL EXTRACT REVISION PAGES FROM A MANUAL

MANYDOC EXTRACT (PRINT) TWO OR MORE DOCUMENTS FROM A DOCUMENT FILE

MTDOC CREATE DOCUMENTATION TO DESCRIBE THE CONTENTS OF A MAGNETIC TAPE

NEWNAME RENAME A SIMPLE ABSOLUTE MODULE

PAGEPRT PRINT SELECTED PAGE(S) FROM A DOCUMENT

PFDOD CREATE PERMANENT FILE DOCUMENTATION

PROGDOC EXTRACT (PRINT) ONE OR ALL DOCUMENT(S) FROM A DOCUMENT FILE

PROMNT MAINTAIN AN ALPHABETICAL, SEQUENTIAL PROCEDURE FILE

PRUDMP OCTAL AND CHARACTER DUMP OF DISK FILE BY RELATIVE PRU NUMBER

PR2UP REFORMAT A SINGLE-COLUMN REPORT FILE COMPOSED OF 60-CHARACTER LINES INTO A DOUBLE-COLUMN FORMAT HAVING A MAXIMUM TOTAL LINE LENGTH OF 132 PRINTABLE CHARACTERS (PLUS 1 POSITION FOR CARRIAGE CONTROL). THE OUTPUT WILL BE SUITABLE FOR PRINTING EITHER ON A LINE PRINTER OR ON XEROX 8-1/2 X 11 PAPER.

PTIM PRINT CPA, CPB, CPA+CPB, IO AND PP TIMES SINCE START OF JOB OR INTERCOM SESSION

PURPOSE EXTRACT PURPOSE INFORMATION FROM DOCUMENTATION FILES (WHICH WERE PREPARED IN THE FORMAT GENERATED BY PROGRAM 'DOC')

REDECK CHANGE AN UPDATE COMPILE FILE BACK INTO A SOURCE FILE

SORTUP GENERATE UPDATE DIRECTIVES TO SORT OLDPL

S2KRNM RENAME ACCOUNT NUMBER ON CATALOGED S2000 DATA BASE FILES

TAPDMP DUMP SELECTED PORTIONS OF A 7-TRACK MAGNETIC TAPE WRITTEN IN AN UNKNOWN DENSITY AND/OR MODE. IT IS CONTROLLED BY A SERIES OF FREE-FIELD CONTROL CARDS CONTAINING ORDERS FOR THE DUMPING, SKIPPING OR BACKSPACING OF RECORDS OR FILES.

TAPLIST PREPARE TWO LISTS FROM MAGTAPEDOCUMENTATION FILE: 1) LIST OF TAPE NUMBER, LABEL, DENSITY, REMARKS AND DESCRIPTION FOR EACH TAPE DOCUMENTED IN FILE 2) LIST OF TAPE NUMBERS AND LABELS

UNDOCIT REMOVE THE PAGING WHICH WAS ADDED TO DOCUMENT(S) BY PROGRAM 'DOCIT'

WHATLIB LIST LIBRARIES SPECIFIED ON LAST LIBRARY CARD

WHICHMF TELL TELETYPE USER WHICH MAINFRAME HE IS USING

WHICHOS TELL TELETYPE USER WHICH OPERATING SYSTEM HE IS USING



## \*\*\* PROGRAMS NOT IN LIBRARIES \*\*\*

SEVERAL PROGRAMS WHICH ARE NOT IN LIBRARIES ARE LISTED BELOW. (SEE THEIR INDIVIDUAL DOCUMENTS FOR ATTACH AND EXECUTE INFORMATION.)

INDIVIDUAL DOCUMENTS MAY BE PRINTED BY:

BEGIN,DOCGET,,OTHER,,<PROG>,OUTPUT.

WHERE <PROG> IS THE NAME OF THE PROGRAM WHOSE DOCUMENTATION IS DESIRED. THE LENGTH OF EACH DOCUMENT IS GIVEN IN PARENTHESES.

ACCTRPT	PROVIDE JOB ORDER MANAGER WITH COMPUTER ACCOUNTING STATUS INFORMATION (3)
ADPCOST	PROVIDE JOB ORDER MANAGER WITH COMPUTER ACCOUNTING STATUS INFORMATION (2)
CCL	CYBER CONTROL LANGUAGE REFERENCE GUIDE (39)
COPYBFR	RECREATE A CDC 'RANDOM' FILE FROM DATA COPIED EARLIER TO A SEQUENTIAL FILE, OR COPY A RANDOM FILE (2)
COPYE	COPY A FILE TO END-OF-INFORMATION (2)
COPYF	COPY BINARY OR CODED FILES (2)
COPYR	COPY BINARY OR CODED RECORDS (2)
COPYRM	COPY AND CONVERT RECORDS ON SEQUENTIAL (SQ) FILES FROM ONE RECORD TYPE AND BLOCK STRUCTURE TO ANOTHER (3)
COPYS	A GENERAL PURPOSE UTILITY FROM NORTHWESTERN UNIVERSITY WHICH PROVIDES A LARGE VARIETY OF COPY OPERATIONS FOR SEQUENTIAL OR RANDOM FILES (4)
COPYSF	COPY FILES OR RECORDS WITH OPTIONAL SHIFT TO RIGHT (3)
CVT360	CONVERT DOUBLE PRECISION S/360 FORTRAN PROGRAMS TO SINGLE PRECISION CDC FORTRAN (1)
EDIT	A UTILITY TO SIMPLIFY AND AUTOMATE THE USE OF UPDATE, PRELCAD AND TSKLOAD (2)
GRIPE	ALLOW USER TO MAKE GRIPES OR SUGGESTIONS DIRECTLY TO THE COMPUTER (3)
MNF	MINNESOTA FORTRAN (MNF) IS AN ALTERNATIVE COMPILER WHICH COMPILES FASTER THAN FTN, INCLUDES STRUCTURED PROGRAMMING FEATURES, AND HAS MORE DIAGNOSTICS AND SIMPLER DEBUG FACILITIES (10)
NETED	TEXT EDITOR (MODELLED AFTER THE STANDARD ARPANET EDITOR) (25)

PFTRANS TRANSFER FILES BETWEEN THE CDC 6700/6600 AND THE CYBER 74 AND  
VICE VERSA (2)

PROSE A TEXT PROCESSOR (31)

PURGALL PURGE (ALL OF) THE FILES OF SPECIFIED AC AND ID (2)

RATFOR CONVERT RATIONAL FORTRAN TEXT INTO CDC FTN TEXT (12)

RENAMAC RENAME CATALOGED ACCOUNT NUMBER. USE WHEN ALL FILES  
CATALOGED UNDER A GIVEN JOB ORDER NUMBER ARE TO BE CHANGED TO  
ANOTHER JOB ORDER NUMBER (2)

RNF TEXT PROCESSOR (45)

NOBOL SNOBOL4 - VERSION 3.10 - USER'S GUIDE (37)

WRITE CHARACTER CONVERSION FOR DOCUMENTS CREATED BY PROSE (10)

\*\* PASCAL \*\*

DOCUMENTS DESCRIBING THE PASCAL 6000 VERSION 3 SYSTEM MAY BE  
PRINTED BY:

BEGIN,DOCGET,,PASCAL,,<DOC>,OUTPUT.

WHERE <DOC> IS:

PASCAL PASCAL 6000 COMPILER RELEASE 3 (92)

PASCLIB PASCAL LIBRARIES (COMPILE-TIME: PSRCLIB; RUN-TIME: PASCLIB)  
(77)

PTOOLS SEVEN DOCUMENTS DESCRIBING EIGHT TOOLS FOR PASCAL PROGRAMS  
(34)

## \*\*\*\*\* SUBPROGRAMS \*\*\*\*\*

THE COMPUTER CENTER MAINTAINS SEVERAL LIBRARIES OF SUBPROGRAMS IN RELOCATABLE OBJECT FORM. THIS CHAPTER DESCRIBES THE FOLLOWING LIBRARIES AND LISTS THE CONTENTS OF EACH WITH DESCRIPTIVE TITLES (REFERENCES ARE GIVEN FOR THE WRITE-UPS):

ARLNALG - AEROSPACE RESEARCH LABORATORIES LINEAR ALGEBRA LIBRARY  
 EISPACK - SOLVE EIGENVALUE AND EIGENVECTOR PROBLEMS  
 FUNPACK - SPECIAL FUNCTIONAL SUBROUTINE PACKAGE FROM ARGONNE NATIONAL LABORATORY  
 IMSL - INTERNATIONAL MATHEMATICAL AND STATISTICAL LIBRARIES PACKAGE  
 LINPACK - SOLVE SYSTEMS OF SIMULTANEOUS LINEAR EQUATIONS  
 MINPACK - SOLVE NON-LINEAR EQUATIONS AND NON-LINEAR LEAST SQUARES PROBLEMS  
 MSL - CDC MATH SCIENCE LIBRARY  
 NSRDC - DTNSRDC WRITTEN AND/OR SUPPORTED SCIENTIFIC AND UTILITY SUBROUTINES  
 SANDIA - ORDINARY DIFFERENTIAL EQUATION SOLVERS FROM SANDIA LABORATORIES

THESE ROUTINES ARE USED PRIMARILY WITH FTN, MNF OR RATFOR PROGRAMS AND MOST ARE CODED IN FTN.

TO ACCESS ANY LIBRARY:

```
ATTACH,<LIB>.
LDSET,LIB=<LIB>.
LGO.
OR
LIBRARY,<LIB>.
OR OTHER LOAD AND EXECUTE CARD(S)
```

FOR EXAMPLE,

```
JOBNAME.
CHARGE,....
FTN.
ATTACH,NSRDC.
LDSET,LIB=NSRDC.
LGO.
' 7/8/9 EOR
PROGRAM TEST (INPUT=128, OUTPUT=128)
...
CALL ANOVA1 (...)
...
END
' 7/8/9 EOR
(DATA CARDS)
" 6/7/8/9 EOI
```

INDIVIDUAL MACHINE-READABLE DOCUMENTS, WHEN AVAILABLE, MAY BE PRINTED (SEE PAGE 1-2).

## ARLNALG

THE AEROSPACE RESEARCH LABORATORIES (ARL) LINEAR ALGEBRA LIBRARY IS A COLLECTION OF 34 SUBROUTINES FOR SOLUTIONS TO LINEAR SYSTEMS AND DETERMINATION OF EIGENVALUES AND EIGENVECTORS OF REAL SYMMETRIC MATRICES. SOME OF THESE ROUTINES ARE SPECIFICALLY OPTIMIZED FOR THE CDC 6000 SERIES COMPUTERS.

REFERENCES: THE ARL LINEAR ALGEBRA LIBRARY HANDBOOK, NIKOLAI AND TSAO, AEROSPACE RESEARCH LABORATORIES, DAYTON, OHIO, JULY 1974, ARL TR 74-0106.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

## ROUTINES IN LIBRARY 'ARLNALG' INCLUDE:

BAC1	EIGENVECTORS OF A SYMMETRIC MATRIX FROM THOSE OF ITS TRIDIAGONAL FORM
BAC2	EIGENVECTORS OF A SYMMETRIC MATRIX FROM THOSE OF ITS TRIDIAGONAL FORM
BISEC	EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX BY THE BISECTION METHOD
FIP	FAST INNER PRODUCT EVALUATION OPTIMIZED FOR THE CDC 6000
IMPR1	ITERATIVE IMPROVEMENT TO MACHINE ACCURACY OF THE SOLUTION X OF $AX = B$ OBTAINED USING SUBROUTINE LEQS1
IMPR2	ITERATIVE IMPROVEMENT TO MACHINE ACCURACY OF THE SOLUTION X OF $AX = B$ OBTAINED USING SUBROUTINE LEQS2
IMQL1	EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC MATRIX
INIT	EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX BY INVERSE ITERATION
LEQS1	SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU1
LEQS2	SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU2
LEQS3	SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU3
LEQS4	SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU4
LEQS5	SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU5
LEQS6	SOLUTION OF A LINEAR SYSTEM GIVEN A TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX PRODUCED BY LU6

LU1 LU FACTORIZATION OF A REAL SQUARE MATRIX

LU2 LU FACTORIZATION OF A REAL SQUARE MATRIX BY THE CROUT METHOD  
WITH ACCUMULATING INNER PRODUCTS

LU3 LU FACTORIZATION OF A REAL SQUARE MATRIX

LU4 LU FACTORIZATION OF A REAL BAND MATRIX A TOGETHER WITH THE  
NUMBER OF POSITIVE EIGENVALUES IF A IS SYMMETRIC

LU5 CHOLESKY FACTORIZATION OF A POSITIVE DEFINITE REAL SYMMETRIC  
MATRIX

LU6 CHOLESKY FACTORIZATION OF A POSITIVE DEFINITE REAL SYMMETRIC  
BAND MATRIX

ORIMP ITERATIVE IMPROVEMENT OF THE SOLUTION X OF  $AX = B$  OBTAINED  
USING SUBROUTINE ORSOL

ORSOL LEAST SQUARES SOLUTION OF A LINEAR SYSTEM GIVEN AN  
ORTHOGONAL-TRIANGULAR FACTORIZATION OF THE COEFFICIENT MATRIX  
PRODUCED BY SUBROUTINE ORTHO

ORTHO ORTHOGONAL TRANSFORMATION OF A GIVEN GENERAL M BY N MATRIX A  
TO UPPER TRIANGULAR FORM

ORTHO2 ORTHOGONAL TRANSFORMATION OF A GENERAL M BY N MATRIX A TO  
UPPER TRIANGULAR FORM AND THE SOLUTION OF THE ASSOCIATED  
LINEAR LEAST SQUARES PROBLEM

QZABX SOLUTION OF THE GENERALIZED MATRIX EIGENVALUE PROBLEM USING  
THE QZ ALGORITHM

REBAKA RECOVERY OF EIGENVECTORS OF GENERALIZED SYMMETRIC EIGENVALUE  
PROBLEM FROM THOSE OF STANDARD FORM PRODUCED BY REDUC1

REDUC1 REDUCTION OF THE GENERALIZED SYMMETRIC EIGENVALUE PROBLEM TO  
STANDARD FORM

RITZIT ITERATIVE COMPUTATION OF EIGENVALUES LARGEST IN MAGNITUDE AND  
CORRESPONDING EIGENVECTORS OF A REAL SYMMETRIC MATRIX

RNQL1 EIGENVALUES OF A REAL SYMMETRIC TRIDIAGONAL MATRIX

SVD SINGULAR VALUE DECOMPOSITION OF A REAL RECTANGULAR MATRIX

TRI1 FAST HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC MATRIX

TRI2 COMPACT HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC  
MATRIX

TRI3 FAST HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC MATRIX  
FOR THE QL ALGORITHM

TRI4 HOUSEHOLDER TRIDIAGONAL FORM OF A REAL SYMMETRIC MATRIX FOR  
THE QL ALGORITHM

## EISPACK

THE EIGENSYSTEM PACKAGE FROM ARGONNE NATIONAL LABORATORY IS A COLLECTION OF 70 SUBROUTINES TO SOLVE EIGENVECTOR AND EIGENVALUE PROBLEMS. ROUTINES IN THIS PACKAGE ARE OFTEN SUPERIOR IN SPEED AND ACCURACY TO SIMILAR ROUTINES IN OTHER PACKAGES.

REFERENCES: LECTURE NOTES IN COMPUTER SCIENCE, VOLUME 6, "MATRIX EIGENSYSTEM ROUTINES - EISPACK GUIDE", SMITH, ET AL, SPRINGER-VERLAG, BERLIN-HEIDELBERG-NEW YORK, 1974.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

## ROUTINES IN LIBRARY 'EISPACK' INCLUDE:

BAKVEC	BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY FIGI
BALANC	BALANCE A REAL GENERAL MATRIX
BALBAK	BACK TRANSFORM THE EIGENVECTORS OF THAT REAL MATRIX TRANSFORMED BY BALANC
BANDR	REDUCE A REAL SYMMETRIC BAND MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS
BANDV	DETERMINE SOME EIGENVECTORS OF A REAL SYMMETRIC BAND MATRIX OR SOLVE BAND EQUATIONS
BISECT	DETERMINE SOME EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX
BQR	DETERMINE SOME EIGENVALUES OF A REAL SYMMETRIC BAND MATRIX
CBABK2	BACK TRANSFORM THE EIGENVECTORS OF THAT COMPLEX MATRIX TRANSFORMED BY CBAL
CBAL	BALANCE A COMPLEX GENERAL MATRIX
CG	DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX GENERAL MATRIX
CH	DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX HERMITIAN MATRIX
CINVT	DETERMINE THOSE EIGENVECTORS OF A COMPLEX UPPER HESSENBERG MATRIX CORRESPONDING TO SPECIFIED EIGENVALUES
COMBAK	BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY COMHES
COMHES	REDUCE A COMPLEX GENERAL MATRIX TO COMPLEX UPPER HESSENBERG FORM USING ELEMENTARY TRANSFORMATIONS
COMLR	DETERMINE THE EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX

COMLR2	DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX UPPER HESSENBERG MATRIX
COMQR	DETERMINE THE EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX
COMQR2	DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A COMPLEX HESSENBERG MATRIX
CORTB	BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY CORTH
CORTH	REDUCE A COMPLEX GENERAL MATRIX TO UPPER HESSENBERG FORM USING UNITARY TRANSFORMATIONS
ELMBAK	BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY ELMHES
ELMHES	REDUCE A REAL GENERAL MATRIX TO UPPER HESSENBERG FORM USING ELEMENTARY TRANSFORMATIONS
ELTRAN	ACCUMULATE THE TRANSFORMATIONS IN THE REDUCTION OF A REAL GENERAL MATRIX BY ELMHES
FIG1	TRANSFORM A CERTAIN REAL NON-SYMMETRIC TRIDIAGONAL MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX
FIGI2	TRANSFORM A CERTAIN REAL NON-SYMMETRIC TRIDIAGONAL MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX ACCUMULATING THE DIAGONAL TRANSFORMATIONS
HQR	DETERMINE THE EIGENVALUES OF A REAL UPPER HESSENBERG MATRIX
HQR2	DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX
HTRIBK	BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY HTRIDI
HTRIB3	BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY HTRID3
HTRIDI	REDUCE A COMPLEX HERMETIAN MATRIX TO A REAL SYMMETRIC TRIDIAGONAL MATRIX USING UNITARY TRANSFORMATIONS
HTRID3	REDUCE A COMPLEX HERMETIAN MATRIX, STORED AS A SINGLE SQUARE ARRAY, TO A REAL SYMMETRIC TRIDIAGONAL MATRIX USING UNITARY TRANSFORMATIONS
IMTQLV	DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX
IMTQL1	DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX
IMTQL2	DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX
INVIT	DETERMINE THOSE EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX CORRESPONDING TO SPECIFIED EIGENVALUES

MINFIT COMPUTE THE SINGULAR VALUE DECOMPOSITION OF AN ARBITRARY REAL RECTANGULAR MATRIX AND THE SOLUTION OF A RELATED LINEAR LEAST SQUARES PROBLEM

ORTBAK BACK TRANSFORM THE EIGENVECTORS OF THAT UPPER HESSENBERG MATRIX DETERMINED BY ORTHES

ORTHES REDUCE A REAL GENERAL MATRIX TO UPPER HESSENBERG FORM USING ORTHOGONAL TRANSFORMATIONS

ORTRAN ACCUMULATE THE TRANSFORMATIONS IN THE REDUCTION OF A REAL GENERAL MATRIX BY ORTHES

QZHES SIMULTANEOUSLY REDUCE ONE OF A PAIR OF REAL GENERAL MATRICES TO UPPER HESSENBERG FORM AND THE OTHER TO UPPER TRIANGULAR FORM USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS

QZIT REDUCE ONE OF A PAIR OF REAL MATRICES FROM UPPER HESSENBERG TO QUASI-UPPER TRIANGULAR FORM WHILE MAINTAINING THE UPPER TRIANGULAR FORM OF THE OTHER USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS

QZVAL EXTRACT THE GENERALIZED EIGENVALUES OF A REAL MATRIX SYSTEM WITH ONE MATRIX IN QUASI-UPPER TRIANGULAR FORM AND THE OTHER IN UPPER TRIANGULAR FORM USING AND OPTIONALLY ACCUMULATING ORTHOGONAL TRANSFORMATIONS

QZVEC DETERMINE THE GENERALIZED EIGENVECTORS OF A REAL MATRIX SYSTEM WITH ONE IN QUASI-UPPER TRIDIAGONAL FORM AND THE OTHER IN UPPER TRIANGULAR FORM USING BACK SUBSTITUTION

RATQR DETERMINE SOME EXTREME EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX

REBAKB BACK TRANSFORM THE EIGENVECTORS OF THAT DERIVED SYMMETRIC MATRIX DETERMINED BY REDUC2

REBAK BACK TRANSFORM THE EIGENVECTORS OF THAT DERIVED SYMMETRIC MATRIX DETERMINED BY REDUC OR REDUC2

REDUC REDUCE A CERTAIN GENERALIZED SYMMETRIC EIGENPROBLEM TO THE STANDARD SYMMETRIC EIGENPROBLEM USING CHOLSKY DECOMPOSITION

REDUC2 REDUCE CERTAIN GENERALIZED SYMMETRIC EIGENPROBLEMS TO STANDARD SYMMETRIC EIGENPROBLEMS USING CHOLSKY DECOMPOSITION

RG DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL GENERAL MATRIX

RGG DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL GENERAL GENERALIZED EIGENPROBLEM  $A * X = (LAMBDA) * B * X$

RS DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC MATRIX



RSB DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC BAND MATRIX

RSG DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL SYMMETRIC GENERALIZED EIGENPROBLEM  $A*X = (LAMBDA)*B*X$

RSGAB DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL SYMMETRIC GENERALIZED EIGENPROBLEM  $A*B*X = (LAMBDA)*X$

RSGBA DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS FOR THE REAL SYMMETRIC GENERALIZED EIGENPROBLEM  $B*A*X = (LAMBDA)*X$

RSP DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC PACKED MATRIX

RST DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A REAL SYMMETRIC TRIDIAGONAL MATRIX

RT DRIVER SUBROUTINE TO DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A CERTAIN REAL TRIDIAGONAL MATRIX

SVD COMPUTE THE SINGULAR VALUE DECOMPOSITION OF AN ARBITRARY REAL RECTANGULAR MATRIX

TINVIT DETERMINE SOME EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX

TQLRAT DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX

TQL1 DETERMINE THE EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX

TQL2 DETERMINE THE EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX

TRBAK1 BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY TRED1

TRBAK3 BACK TRANSFORM THE EIGENVECTORS OF THAT SYMMETRIC TRIDIAGONAL MATRIX DETERMINED BY TRED3

TRED1 REDUCE A REAL SYMMETRIC MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX USING ORTHOGONAL TRANSFORMATIONS

TRED2 RETURN A REAL SYMMETRIC MATRIX TO A SYMMETRIC TRIDIAGONAL MATRIX ACCUMULATING THE ORTHOGONAL TRANSFORMATIONS

TRED3 REDUCE A REAL SYMMETRIC MATRIX, STORED AS A ONE-DIMENSIONAL ARRAY, TO A SYMMETRIC TRIDIAGONAL MATRIX USING ORTHOGONAL TRANSFORMATIONS

TRIDIB DETERMINE SOME EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX

TSTURM DETERMINE SOME EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX

## FUNPACK

SPECIAL FUNCTIONAL SUBROUTINE PACKAGE FROM ARGONNE NATIONAL LABORATORY CONTAINING 24 USER-CALLABLE ROUTINES FOR BESSEL FUNCTIONS, DAWSON'S INTEGRAL, ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND AND EXPONENTIAL INTEGRAL.

REFERENCES: MASTER DOCUMENTS ON FILE IN USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

## ROUTINES IN LIBRARY 'FUNPACK' INCLUDE:

BESEI0    FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST  
          KIND OF ORDER ZERO,  $\exp(-\text{ABS}(X)) * I_0(X)$

BESEI1    FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST  
          KIND OF ORDER ONE,  $\exp(-\text{ABS}(X)) * I_1(X)$

BESEK0    COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER  
          ZERO,  $\exp(X) * K_0(X)$ , FOR REAL, POSITIVE X

BESEK1    COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER  
          ONE,  $\exp(X) * K_1(X)$ , FOR REAL, POSITIVE X

BESIO    FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST  
          KIND OF ORDER ZERO,  $I_0(X)$

BESI1    FUNCTION TO CALCULATE MODIFIED BESSEL FUNCTIONS OF THE FIRST  
          KIND OF ORDER ONE,  $I_1(X)$

BESJ0    FUNCTION TO CALCULATE BESSEL FUNCTIONS OF THE FIRST KIND OF  
          ORDER ZERO,  $J_0(X)$

BESJ1    FUNCTION TO CALCULATE BESSEL FUNCTIONS OF THE FIRST KIND OF  
          ORDER ONE,  $J_1(X)$

BESK0    COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER  
          ZERO,  $K_0(X)$ , FOR REAL, POSITIVE X

BESK1    COMPUTE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND OF ORDER  
          ONE,  $K_1(X)$ , FOR REAL, POSITIVE X

BESY    SUBROUTINE TO COMPUTE BESSEL FUNCTIONS OF THE SECOND KIND OF  
          NON-NEGATIVE ORDER,  $Y\text{-SUB-}NU(X)$ , FOR REAL, POSITIVE X (SEE  
          YNU)

DAW    FUNCTION TO COMPUTE DAWSON'S INTEGRAL FOR ALL REAL ARGUMENTS

EI	COMPUTE EXPONENTIAL INTEGRAL, $EI(X)$
ELIE1	COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE SECOND KIND, $E(CAY^{**2})$
ELIEM	COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE SECOND KIND, $E(1-ETA)$
ELIK1	COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND, $K(CAY^{**2})$
ELIKM	COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND, $K(1-ETA)$
ELIPE	COMPUTE COMPLETE COMPLETE ELLIPTIC INTEGRALS OF THE SECOND KIND, $E(CAYSQ)$
ELIPK	COMPUTE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST KIND, $K(CAYSQ)$
EONE	COMPUTE EXPONENTIAL INTEGRAL, $E-SUB-1(X)$
EXPEI	COMPUTE EXPONENTIAL INTEGRAL, $EXP(-X)*EI(X)$
MONERR	ERROR HANDLING FACILITIES, INCLUDING USER INTERACTION, FOR FUNPACK
PSI	FUNCTION TO COMPUTE LOGARITHMIC DERIVATIVE OF THE GAMMA FUNCTION FOR REAL ARGUMENTS
YNU	FUNCTION TO COMPUTE BESSEL FUNCTIONS OF THE SECOND KIND OF NON-NEGATIVE REAL ORDER, $Y-SUB-NU(X)$ , FOR REAL, POSITIVE $X$ (SEE BESY)

## IMSL (PROPRIETARY)

THE INTERNATIONAL MATHEMATICAL AND STATISTICAL LIBRARIES PACKAGE (EDITION 8) CONTAINS OVER 450 SUBROUTINES IN THE FOLLOWING AREAS:

- A - ANALYSIS OF EXPERIMENTAL DESIGN DATA
- B - BASIC STATISTICS
- C - CATEGORIZED DATA ANALYSIS
- D - DIFFERENTIAL EQUATIONS, QUADRATURE, DIFFERENTIATION
- E - EIGENANALYSIS
- F - FORECASTING, ECONOMETRICS, TIME SERIES
- G - GENERATION AND TESTING OF RANDOM NUMBERS, GOODNESS OF FIT
- I - INTERPOLATION, APPROXIMATION AND SMOOTHING
- L - LINEAR ALGEBRAIC EQUATIONS
- M - MATHEMATICAL AND STATISTICAL SPECIAL FUNCTIONS
- N - NONPARAMETRIC STATISTICS
- O - OBSERVATION STRUCTURE
- R - REGRESSION ANALYSIS
- S - SAMPLING
- U - UTILITY FUNCTIONS
- V - VECTOR-MATRIX ARITHMETIC
- Z - ZEROS AND EXTREMA, LINEAR PROGRAMMING

REFERENCES: THE IMSL LIBRARY, VOLUMES 1 AND 2.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING  
PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

## ROUTINES IN LIBRARY 'IMSL' INCLUDE:

- |        |   |
|--------|---|
| ABIBN  | ANALYSIS OF BALANCED INCOMPLETE BLOCK AND BALANCED LATTICE DESIGNS  |
| ACRDAN | ANALYSIS OF ONE-WAY CLASSIFICATION DESIGN DATA  |
| ACTRST | CONTRAST ESTIMATES AND SUMS OF SQUARES  |
| AFACN  | FULL FACTORIAL PLAN ANALYSIS  |
| AFACT  | SUMS OF SQUARES, MEAN SQUARES, DEGREES OF FREEDOM, AND MEANS FOR ALL EFFECTS IN A FULL FACTORIAL PLAN, ALLOWING REPLICATION ON OPTION |
| AGBACP | ANALYSIS OF BALANCED COMPLETE EXPERIMENTAL DESIGN STRUCTURE DATA  |
| AGLMOD | GENERAL LINEAR MODEL ANALYSIS   |
| AGVACL | ONE OR TWO-SIDED INTERVAL ESTIMATE OF A VARIANCE COMPONENT  |
| AGXPM  | EXPECTED MEAN SQUARES FOR BALANCED COMPLETE DESIGN MODELS   |
| ALGAMA | EVALUATE THE LOG (BASE E) OF THE ABSOLUTE VALUE OF THE GAMMA FUNCTION (GLGAMA=ALGAMA)   |

ALSQAN	ANALYSIS OF LATIN SQUARE DESIGN DATA
AMEANS	PREPARATION OF A SET OF UNBALANCED DATA FOR ANALYSIS BY THE METHOD OF UNWEIGHTED MEANS
ANCOV1	COVARIANCE ANALYSIS FOR ONE-WAY CLASSIFICATION DESIGN DATA
ANESTE	ANALYSIS OF COMPLETELY NESTED DESIGN DATA WITH EQUAL NUMBERS IN THE SUBCLASSES
ANESTU	ANALYSIS OF COMPLETELY NESTED DESIGN DATA WITH UNEQUAL NUMBERS IN THE SUBCLASSES
AORDR	REORDERING OF THE DATA OBTAINED FROM ANY BALANCED COMPLETE EXPERIMENTAL DESIGN
ARCBAN	ANALYSIS OF TWO-WAY CLASSIFICATION DESIGN DATA
ASNKMC	STUDENT-NEWMAN-KEULS MULTIPLE COMPARISON TEST
BDCOU1	TALLY OF OBSERVATIONS INTO A ONE-WAY FREQUENCY TABLE
BDCOU2	TALLY OF OBSERVATIONS INTO A TWO-WAY FREQUENCY TABLE
BDLTV	PRODUCE LETTER-VALUE SUMMARY
BDTRG1	TRANSGENERATION OF THE COLUMNS OF A MATRIX (IN-CORE VERSION)
BDTRGO	TRANSGENERATION OF THE COLUMNS OF A MATRIX (OUT-OF-CORE VERSION)
BECOR	ESTIMATES OF MEANS, STANDARD DEVIATIONS, AND CORRELATION COEFFICIENTS (OUT-OF-CORE VERSION)
BECORI	ESTIMATES OF MEANS, STANDARD DEVIATIONS, AND CORRELATION COEFFICIENTS (IN-CORE VERSION)
BECOVN	MEANS AND VARIANCE-COVARIANCE MATRIX
BECTR	TETRACHORIC CORRELATION COEFFICIENT ESTIMATION
BECVL	VARIANCES AND COVARIANCES OF LINEAR FUNCTIONS (OUT-OF-CORE VERSION)
BECVLI	VARIANCES AND COVARIANCES OF LINEAR FUNCTIONS (IN-CORE VERSION)
BGRPS	MOMENTS ESTIMATION FOR GROUPED DATA WITH AND WITHOUT SHEPPARDS CORRECTIONS
BEIGRP	ESTIMATION OF BASIC STATISTICAL PARAMETERS USING GROUPED DATA
BEIUGR	ESTIMATION OF BASIC STATISTICAL PARAMETERS USING UNGROUPED DATA
BELBIN	INTERVAL ESTIMATE OF THE PARAMETER P OF THE BINOMIAL DISTRIBUTION

BELPOS INTERVAL ESTIMATE OF THE PARAMETER LAMBDA OF THE POISSON DISTRIBUTION

BEMDP MEDIAN POLISH OF A TWO-WAY TABLE

BEMIRI ESTIMATES OF MEANS, SIMPLE REGRESSION COEFFICIENTS, THEIR INTERCEPTS, STANDARD ERRORS OF THE REGRESSION COEFFICIENTS, AND STANDARD DEVIATIONS FOR ARRAYS WHICH CONTAIN MISSING VALUES (IN-CORE VERSION)

BEMIRO ESTIMATES OF MEANS, SIMPLE REGRESSION COEFFICIENTS, THEIR INTERCEPTS, STANDARD ERRORS OF THE REGRESSION COEFFICIENTS, AND STANDARD DEVIATIONS FOR ARRAYS WHICH CONTAIN MISSING VALUES (OUT-OF-CORE VERSION)

BEMMI ESTIMATES OF MEANS, STANDARD DEVIATIONS, CORRELATION COEFFICIENTS, SKEWNESS AND KURTOSIS FROM A DATA MATRIX CONTAINING MISSING OBSERVATIONS (IN-CORE VERSION)

BEMMO ESTIMATES OF MEANS, STANDARD DEVIATIONS, CORRELATION COEFFICIENTS, SKEWNESS AND KURTOSIS FROM A DATA MATRIX CONTAINING MISSING OBSERVATIONS (OUT OF CORE VERSION)

BEMNON LOCATION (MEAN) INFERENCES USING A SAMPLE FROM A NORMAL POPULATION WITH KNOWN VARIANCE

BEMSON MEAN AND VARIANCE INFERENCES USING A SAMPLE FROM A NORMAL POPULATION

BENSON VARIANCE INFERENCES USING A SAMPLE FROM A NORMAL POPULATION WITH KNOWN MEAN

BEPAT MEAN AND VARIANCE INFERENCES USING SAMPLES FROM EACH OF TWO NORMAL POPULATIONS WITH UNEQUAL VARIANCES

BEPET MEAN AND VARIANCE INFERENCES USING SAMPLES FROM EACH OF TWO NORMAL POPULATIONS WITH EQUAL VARIANCES

BESRB BISERIAL AND POINT-BISERIAL CORRELATION COEFFICIENTS FOR A QUALITATIVELY DICHOTOMIZED VARIABLE AND A NUMERICALLY MEASURABLE AND CLASSIFIED VARIABLE

BESRN BISERIAL CORRELATION COEFFICIENT FOR A QUALITATIVELY DICHOTOMIZED VARIABLE AND A NUMERICALLY OR QUALITATIVELY CLASSIFIED VARIABLE

CAXPY COMPUTE A CONSTANT TIMES A VECTOR PLUS A VECTOR, ALL COMPLEX (VBLA=CAXPY)

CBNRHO ESTIMATION OF THE BIVARIATE NORMAL CORRELATION COEFFICIENT USING A CONTINGENCY TABLE

CCOPY COPY A VECTOR X TO A VECTOR Y, BOTH COMPLEX (VBLA=CCOPY)

CDOTC COMPUTE COMPLEX DOT PRODUCT USING CONJUGATED VECTOR COMPONENTS (VBLA=CDOTC)

CDOTU	COMPUTE COMPLEX DOT PRODUCT USING UNCONJUGATED VECTOR COMPONENTS (VBLA=CDOTU)
CSCAL	COMPUTE A COMPLEX CONSTANT TIMES A COMPLEX VECTOR (VBLA=CSCAL)
CSSCAL	COMPUTE A REAL CONSTANT TIMES A COMPLEX VECTOR (VBLA=CSSCAL)
CSWAP	INTERCHANGE VECTORS X AND Y, BOTH COMPLEX (VBLA=CSWAP)
CTLLF	LOG-LINEAR FIT OF CONTINGENCY TABLE
CTPR	COMPUTE EXACT PROBABILITIES FOR CONTINGENCY TABLES
CTRBYC	ANALYSIS OF A CONTINGENCY TABLE
CZDOTC	COMPUTE COMPLEX DOT PRODUCT USING CONJUGATED VECTOR COMPONENTS (AND DOUBLE PRECISION ACCUMULATION) (VBLA=CZDOTC)
CZDOTU	COMPUTE COMPLEX DOT PRODUCT USING UNCONJUGATED VECTOR COMPONENTS (AND DOUBLE PRECISION ACCUMULATION) (VBLA=CZDOTU)
DASUM	COMPUTE DOUBLE PRECISION SUM OF ABSOLUTE VALUES (VBLA=DASUM)
DAXPY	COMPUTE A CONSTANT TIMES A VECTOR PLUS A VECTOR, ALL DOUBLE PRECISION (VBLA=DAXPY)
DBCEVU	BICUBIC SPLINE MIXED PARTIAL DERIVATIVE EVALUATOR
DBCQDU	BICUBIC SPLINE QUADRATURE
DBLINT	NUMERICAL INTEGRATION BY ADAPTIVE ROMBERG METHOD (OVER A RECTANGLE)
DCADRE	NUMERICAL INTEGRATION OF A FUNCTION USING CAUTIOUS ADAPTIVE ROMBERG EXTRAPOLATION
DCOPY	COPY A VECTOR X TO A VECTOR Y, BOTH DOUBLE PRECISION (VBLA=DCOPY)
DCSEVU	CUBIC SPLINE FIRST AND SECOND DERIVATIVE EVALUATOR
DCSQDU	CUBIC SPLINE QUADRATURE
DDOT	COMPUTE DOUBLE PRECISION DOT PRODUCT (VBLA=DDOT)
DGEAR	DIFFERENTIAL EQUATION SOLVER - VARIABLE ORDER ADAMS PREDICTOR CORRECTOR METHOD OR GEARS METHOD
DNRM2	COMPUTE THE EUCLIDEAN LENGTH OR L2 NORM OF A DOUBLE PRECISION VECTOR (VBLA=DNRM2)
DREBS	DIFFERENTIAL EQUATION SOLVER - BURLISCH-STOER EXTRAPOLATION METHOD

DROT      APPLY GIVENS PLANE ROTATION (DOUBLE PRECISION) (VBLA=DROT)

DROTG     CONSTRUCT    GIVENS    PLANE    ROTATION    (DOUBLE    PRECISION)  
          (VBLA=DROTG)

DROTM     APPLY   A   MODIFIED   GIVENS   PLANE ROTATION (DOUBLE PRECISION)  
          (VBLA=DROTM)

DROTMG    CONSTRUCT A MODIFIED GIVENS PLANE ROTATION (DOUBLE PRECISION)  
          (VBLA=DROTMG)

DSCAL     COMPUTE   A DOUBLE PRECISION CONSTANT TIMES A DOUBLE PRECISION  
          VECTOR (VBLA=DSCAL)

DSDOT     COMPUTE   SINGLE   PRECISION DOT PRODUCT USING DOUBLE PRECISION  
          ACCUMULATION (VBLA=DSDOT)

DSWAP     INTERCHANGE   VECTORS   X   AND   Y,   BOTH   DOUBLE   PRECISION  
          (VBLA=DSWAP)

DTPTB     MULTIPLE SHOOTING METHOD (BOUNDARY VALUE)

DVERK     DIFFERENTIAL EQUATION SOLVER - RUNGE KUTTA-VERNER FIFTH AND  
          SIXTH ORDER METHOD

EBALAC    BALANCE   A   COMPLEX   GENERAL   MATRIX   AND ISOLATE EIGENVALUES  
          WHENEVER POSSIBLE

EBALAF    BALANCE A REAL MATRIX IN THE EUCLIDEAN NORM

EBBCKC    BACK TRANSFORMATION OF THE EIGENVECTORS OF A BALANCED COMPLEX  
          MATRIX TO FORM THE EIGEN- VECTORS OF THE ORIGINAL MATRIX

EBBCKF    BACK TRANSFORMATION OF THE EIGENVECTORS OF A BALANCED REAL  
          MATRIX TO FORM THE EIGEN- VECTORS OF THE ORIGINAL MATRIX

EHBCKF    BACK TRANSFORMATION OF THE EIGENVECTORS OF A REAL UPPER  
          HESSENBERG MATRIX TO FORM THE EIGENVECTORS OF THE ORIGINAL  
          MATRIX

EHBCKH    BACK TRANSFORMATION OF THE EIGENVECTORS OF A REAL SYMMETRIC  
          TRIDIAGONAL MATRIX OBTAINED FROM THE HOUSEHOLDER REDUCTION OF  
          A HERMITIAN MATRIX

EHESSC    REDUCTION OF A GENERAL COMPLEX MATRIX TO COMPLEX UPPER  
          HESSENBERG FORM

EHESSF    REDUCTION OF A NONSYMMETRIC MATRIX TO UPPER HESSENBERG FORM  
          BY ORTHOGONAL TRANSFORMATIONS

EHOBKS    BACK TRANSFORMATION TO FORM THE EIGENVECTORS OF THE ORIGINAL  
          SYMMETRIC MATRIX FROM THE EIGENVECTORS OF THE TRIDIAGONAL  
          MATRIX

EHOUSH    REDUCTION OF A COMPLEX HERMITIAN MATRIX TO REAL SYMMETRIC  
          TRIDIAGONAL FORM



EHOUS    REDUCTION OF A SYMMETRIC MATRIX TO SYMMETRIC TRIDIAGONAL FORM  
         USING A HOUSEHOLDER REDUCTION

EIGBS    EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A BAND  
         SYMMETRIC MATRIX

EIGCC    EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A COMPLEX  
         GENERAL MATRIX

EIGCH    EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A COMPLEX  
         HERMITIAN MATRIX

EIGRF    EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A REAL GENERAL  
         MATRIX IN FULL STORAGE MODE

EIGRS    EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A REAL SYMMETRIC  
         MATRIX IN SYMMETRIC STORAGE MODE

EIGZC    EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF THE SYSTEM  
          $A*X=LAMBDA*B*X$  WHERE A AND B ARE COMPLEX MATRICES

EIGZF    EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF THE SYSTEM  
          $A*X=LAMBDA*B*X$  WHERE A AND B ARE REAL MATRICES

ELRH1C   EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX

ELRH2C   EIGENVALUES AND EIGENVECTORS OF A COMPLEX UPPER HESSENBERG  
         MATRIX AND BACKTRANS- FORMATION OF THE EIGENVECTORS

ELZHC    REDUCE TWO COMPLEX MATRICES, A AND B, SIMUL- TANEOUSLY, A TO  
         UPPER HESSENBERG AND B TO UPPER TRIANGULAR FORM

ELZVC    CALCULATE THE EIGENVALUES AND, OPTIONALLY, EIGENVECTORS OF  
         THE SYSTEM  $A*Z=LAMBDA*B*Z$  WHERE COMPLEX MATRIX A IS UPPER  
         HESSENBERG AND COMPLEX MATRIX B IS UPPER TRIANGULAR

EQRH1F   EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX CORRESPONDING  
         TO SPECIFIED EIGENVALUES

EQRH3F   EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A REAL UPPER  
         HESSENBERG MATRIX

EQRT1S   SMALLEST OR LARGEST M EIGENVALUES OF A SYMMETRIC TRIDIAGONAL  
         MATRIX

EQRT2S   EIGENVALUES AND (OPTIONALLY) EIGENVECTORS OF A SYMMETRIC  
         TRIDIAGONAL MATRIX USING THE QL METHOD

EQRT3S   THE SMALLEST (OR LARGEST) EIGENVALUES OF A TRIDIAGONAL MATRIX  
         IN ALGEBRAIC VALUE WHOSE SUM EXCEEDS A GIVEN VALUE

EQZQF    HESSENBERG REDUCTION FOR THE GENERALIZED EIGENVALUE PROBLEM  
          $A*X=LAMBDA*B*X$ . REDUCTION OF A TO UPPER HESSENBERG FORM AND  
         B TO UPPER TRIANGULAR FORM

EQZTF      EXPLICIT QZ ITERATION FOR THE GENERALIZED EIGENVALUE PROBLEM  
             $A * X = \text{LAMBDA} * B * X$  WHERE A IS IN UPPER HESSENBERG FORM AND B IS  
            UPPER TRIANGULAR. A IS REDUCED TO QUASI-UPPER TRIANGULAR  
            FORM WHILE KEEPING MATRIX B UPPER TRIANGULAR

EQZVF      EIGENVALUES AND OPTIONALLY, EIGENVECTORS OF THE GENERALIZED  
            EIGENVALUE PROBLEM  $A * Z = \text{LAMBDA} * B * Z$  WHERE B IS UPPER TRIANGULAR  
            AND A IS QUASI-UPPER TRIANGULAR.

ERF        EVALUATE THE ERROR FUNCTION (MERF=ERF)

ERFC       EVALUATE THE COMPLEMENTED ERROR FUNCTION (MERRC=ERFC)

FFTCC      FAST FOURIER TRANSFORM OF A COMPLEX VALUED SEQUENCE

FFTRC      FAST FOURIER TRANSFORM OF A REAL VALUED SEQUENCE

FFTSC      SINE AND COSINE TRANSFORMS OF A REAL VALUED SEQUENCE

FFT2C      FAST FOURIER TRANSFORM OF A COMPLEX VALUED SEQUENCE OF LENGTH  
            EQUAL TO A POWER TWO

FFT3D      FAST FOURIER TRANSFORM OF A COMPLEX VALUED ARRAY

FLINV      INVERSE LAPLACE TRANSFORM OF A COMPLEX FUNCTION

FTARPS     PRELIMINARY ESTIMATION OF THE AUTOREGRESSIVE PARAMETERS IN AN  
            ARIMA STOCHASTIC MODEL

FTAUTO     MEAN, VARIANCE, AUTOCOVARIANCES, AUTOCORRELATIONS, AND  
            PARTIAL AUTOCORRELATIONS FOR A STATIONARY TIME SERIES

FTCAST     TIME SERIES FORECASTS AND PROBABILITY LIMITS USING AN ARIMA  
            (BOX-JENKINS) MODEL

FTCMP      NON-SEASONAL ARIMA (BOX-JENKINS) STOCHASTIC MODEL ANALYSIS  
            FOR A SINGLE TIME SERIES WITH FULL PARAMETER ITERATION AND  
            MAXIMUM LIKELIHOOD ESTIMATION

FTCROS     MEANS, VARIANCES, CROSS-COVARIANCES, AND CROSS-CORRELATIONS  
            FOR TWO MUTUALLY STATIONARY N CHANNEL TIME SERIES

FTCRXY     CROSS-COVARIANCE OF TWO MUTUALLY STATIONARY TIME SERIES

FTFPS      FAST FOURIER TRANSFORM ESTIMATES OF POWER SPECTRA AND CROSS  
            SPECTRA OF TIME SERIES

FTFREQ     SINGLE OR MULTICHANNEL TIME SERIES ANALYSIS IN THE TIME AND  
            FREQUENCY DOMAINS

FTGEN      GENERATION OF A TIME SERIES FROM A GIVEN ARIMA (BOX-JENKINS)  
            STOCHASTIC MODEL

FTKALM	KALMAN FILTERING
FTMPS	PRELIMINARY ESTIMATION OF THE MOVING AVERAGE PARAMETERS IN AN ARIMA STOCHASTIC MODEL
FTMXL	MAXIMUM LIKELIHOOD ESTIMATION OF AUTOREGRESSIVE AND MOVING AVERAGE PARAMETERS IN AN ARIMA (BOX-JENKINS) STOCHASTIC MODEL
FTRDIF	TRANSFORMATIONS, DIFFERENCES AND SEASONAL DIFFERENCES OF A TIME SERIES FOR MODEL IDENTIFICATION
FTRRN	PRELIMINARY PARAMETER ESTIMATES FOR A UNIVARIATE TRANSFER FUNCTION MODEL
FTWEIN	WIENER FORECAST FOR A STATIONARY STOCHASTIC PROCESS
FTWENM	MULTICHANNEL WIENER FORECAST
FTWENX	MAXIMUM LIKELIHOOD PARAMETER ESTIMATES FOR A MULTICHANNEL, SINGLE OUTPUT TIME SERIES MODEL
GAMMA	EVALUATE THE GAMMA FUNCTION
GFIT	CHI-SQUARED GOODNESS OF FIT TEST
GGAMR	ONE PARAMETER GAMMA RANDOM DEVIATE GENERATOR, AND USABLE AS THE BASIS FOR TWO PARAMETER GAMMA, EXPONENTIAL, CHI-SQUARED, CHI, BETA, T, AND F DEVIATE GENERATION
GGBN	BINOMIAL RANDOM DEVIATE GENERATOR
GGBNR	NEGATIVE BINOMIAL RANDOM DEVIATE GENERATOR
GGBTR	BETA RANDOM DEVIATE GENERATOR
GGCAY	CAUCHY RANDOM DEVIATE GENERATOR
GGCHS	CHI-SQUARED RANDOM DEVIATE GENERATOR
GGDA	GENERAL DISCRETE DISTRIBUTION RANDOM DEVIATE GENERATOR USING ALIAS METHOD
GGDT	GENERAL DISCRETE DISTRIBUTION RANDOM DEVIATE GENERATOR USING TABLE LOOKUP
GGEOT	GEOMETRIC RANDOM DEVIATE GENERATOR
GGEXN	EXPONENTIAL RANDOM DEVIATE GENERATOR
GGEXT	RANDOM DEVIATE GENERATOR FOR MIXTURE OF TWO EXPONENTIALS
GGHPR	HYPERGEOMETRIC RANDOM DEVIATE GENERATOR
GGMAR	ONE PARAMETER GAMMA RANDOM DEVIATE GENERATOR WITH EXTENSIONS
GGMTN	MULTINOMIAL RANDOM DEVIATE GENERATOR

GGNLG LOG-NORMAL RANDOM DEVIATE GENERATOR

GGNML NORMAL OR GAUSSIAN RANDOM DEVIATE GENERATOR

GGNPM NORMAL RANDOM DEVIATE GENERATOR VIA THE POLAR METHOD

GGNQF NORMAL RANDOM DEVIATE GENERATOR - FUNCTION FORM OF GGNML

GGNSM MULTIVARIATE NORMAL RANDOM DEVIATE GENERATOR WITH GIVEN COVARIANCE MATRIX

GGPON POISSON RANDOM DEVIATE GENERATOR WHERE THE POISSON PARAMETER CHANGES FREQUENTLY

GGPOS POISSON RANDOM DEVIATE GENERATOR WHERE THE POISSON PARAMETER DOES NOT CHANGE OFTEN

GGSPH GENERATION OF UNIFORM RANDOM DEVIATES FROM THE SURFACE OF THE UNIT SPHERE IN 3 OR 4 SPACE

GGSTA STABLE DISTRIBUTION RANDOM DEVIATE GENERATOR

GGTRA TRIANGULAR DISTRIBUTION RANDOM DEVIATE GENERATOR

GGUBFS BASIC UNIFORM (0,1) RANDOM NUMBER GENERATOR - FUNCTION FORM OF GGUBS

GGUBS BASIC UNIFORM (0,1) PSEUDO-RANDOM NUMBER GENERATOR

GGUBT UNIFORM (0,1) PSEUDO-RANDOM NUMBER GENERATOR USING ALTERNATE MULTIPLIER

GGUD DISCRETE UNIFORM RANDOM NUMBER GENERATOR

GGUW UNIFORM (0,1) RANDOM NUMBER GENERATOR WITH SHUFFLING

GGVCR GENERAL CONTINUOUS DISTRIBUTION RANDOM DEVIATE GENERATOR

GGWIB WEIBULL RANDOM DEVIATE GENERATOR

GTCN SAMPLE SIZE OR NUMBER OF CLASS INTERVALS DETERMINATION FOR CHI-SQUARED TEST APPLICATIONS

GTDDU D-SQUARE TALLY

GTD2T THE D-SQUARE TEST

GTMNT MOMENTS AND STANDARDIZED MOMENTS OF UNIFORM RANDOM NUMBERS

GTNOR TEST FOR NORMALITY OF RANDOM DEVIATES

GTPBC COUNT OF THE NUMBER OF ZERO BITS IN A GIVEN SUBSET OF A REAL WORD

GTPKP PROBABILITY DISTRIBUTION OF N ELEMENTS INTO TWO EQUI-PROBABLE STATES

GTPL	POKER TEST TALLY OF HAND TYPES AND STATISTICS
GTPOK	PERFORM THE POKER TEST
GTPR	TALLY OF COORDINATES OF PAIRS (OR LAGGED PAIRS) OF RANDOM NUMBERS
GTPST	PAIRS TEST OR GOODS SERIAL TEST
GTRN	RUNS TEST
GTRTN	TALLY OF NUMBER OF RUNS UP AND DOWN
GTTRT	TALLY FOR TRIPLETS TEST
GTTT	TRIPLETS TEST
IBCEVU	BICUBIC SPLINE EVALUATOR
IBCICU	BICUBIC SPLINE TWO-DIMENSIONAL COEFFICIENT CALCULATOR
IBCIEU	BICUBIC SPLINE TWO-DIMENSIONAL INTERPOLATOR
ICAMAX	FIND THE SMALLEST INDEX OF THE MAXIMUM MAGNITUDE OF A COMPLEX VECTOR (VBLA=ICAMAX)
ICSCCU	INTERPOLATION BY CUBIC SPLINES (EASY TO USE)
ICSEVU	EVALUATION OF A CUBIC SPLINE
ICSFKU	LEAST SQUARES APPROXIMATION BY CUBIC SPLINES - FIXED KNOTS
ICSICU	INTERPOLATORY APPROXIMATION BY CUBIC SPLINES WITH ARBITRARY SECOND DERIVATIVE END CONDITIONS
ICSMOU	ONE-DIMENSIONAL DATA SMOOTHING BY ERROR DETECTION
ICSPLN	INTERPOLATION BY CUBIC SPLINES WITH PERIODIC END CONDITIONS
ICSSCU	CUBIC SPLINE DATA SMOOTHER WITH USER SUPPLIED PARAMETER
ICSSCV	CUBIC SPLINE DATA SMOOTHER (EASY TO USE)
ICSVKU	LEAST SQUARES APPROXIMATION BY CUBIC SPLINES - VARIABLE KNOTS
IDAMAX	FIND THE SMALLEST INDEX OF THE MAXIMUM MAGNITUDE OF A DOUBLE PRECISION VECTOR (VBLA=IDAMAX)
IFLSQ	LEAST SQUARES APPROXIMATION WITH USER SUPPLIED BASIS FUNCTIONS
IQHSCU	ONE-DIMENSIONAL QUASI-CUBIC HERMITE INTERPOLATION
IQHSCV	SMOOTH SURFACE FITTING WITH IRREGULARLY DISTRIBUTED DATA POINTS (INTERPOLATION)

IRATCU	RATIONAL WEIGHTED CHEBYCHEV APPROXIMATION OF A CONTINUOUS FUNCTION
ISAMAX	FIND THE SMALLEST INDEX OF THE MAXIMUM MAGNITUDE OF A SINGLE PRECISION VECTOR (VBLA=ISAMAX)
LEQT1B	LINEAR EQUATION SOLUTION - BAND STORAGE MODE - SPACE ECONOMIZER SOLUTION
LEQT1C	MATRIX DECOMPOSITION, LINEAR EQUATION SOLUTION - SPACE ECONOMIZER SOLUTION - COMPLEX MATRICES
LEQT1F	LINEAR EQUATION SOLUTION - FULL STORAGE MODE - SPACE ECONOMIZER SOLUTION
LEQT1P	LINEAR EQUATION SOLUTION - POSITIVE DEFINITE MATRIX - SYMMETRIC STORAGE MODE - SPACE ECONOMIZER SOLUTION
LEQT2B	LINEAR EQUATION SOLUTION - BAND STORAGE MODE - HIGH ACCURACY SOLUTION
LEQT2F	LINEAR EQUATION SOLUTION - FULL STORAGE MODE - HIGH ACCURACY SOLUTION
LEQT2P	LINEAR EQUATION SOLUTION - POSITIVE DEFINITE MATRIX - SYMMETRIC STORAGE MODE - HIGH ACCURACY SOLUTION
LEQ1PB	LINEAR EQUATION SOLUTION - POSITIVE DEFINITE SYMMETRIC BAND MATRIX - BAND SYMMETRIC STORAGE MODE - SPACE ECONOMIZER SOLUTION
LEQ1S	LINEAR EQUATION SOLUTION - INDEFINITE MATRIX - SYMMETRIC STORAGE MODE - SPACE ECONOMIZER SOLUTION
LEQ2C	LINEAR EQUATION SOLUTION - COMPLEX MATRIX - HIGH ACCURACY SOLUTION
LEQ2PB	LINEAR EQUATION SOLUTION - POSITIVE DEFINITE BAND SYMMETRIC MATRIX - BAND SYMMETRIC STORAGE MODE - HIGH ACCURACY SOLUTION
LEQ2S	LINEAR EQUATION SOLUTION - INDEFINITE MATRIX - SYMMETRIC STORAGE MODE - HIGH ACCURACY SOLUTION
LGINF	GENERALIZED INVERSE OF REAL MATRIX
LINV1F	INVERSION OF A MATRIX - FULL STORAGE MODE - SPACE ECONOMIZER SOLUTION
LINV1P	INVERSION OF MATRIX - POSITIVE DEFINITE - SYMMETRIC STORAGE MODE - SPACE ECONOMIZER SOLUTION
LINV2F	INVERSION OF A MATRIX - FULL STORAGE MODE - HIGH ACCURACY SOLUTION
LINV2P	INVERSION OF A MATRIX - POSITIVE DEFINITE - SYMMETRIC STORAGE MODE - HIGH ACCURACY SOLUTION

LINV3F IN PLACE INVERSE, EQUATION SOLUTION, AND/OR DETERMINANT  
EVALUATION - FULL STORAGE MODE

LINV3P IN PLACE INVERSE, EQUATION SOLUTION, POSITIVE DEFINITE MATRIX  
- SYMMETRIC STORAGE MODE

LIN1PB INVERSION OF A MATRIX - POSITIVE DEFINITE BAND SYMMETRIC  
MATRIX - BAND SYMMETRIC STORAGE MODE - SPACE ECONOMIZER  
SOLUTION

LIN2PB INVERSION OF MATRIX - POSITIVE DEFINITE BAND SYMMETRIC MATRIX  
- BAND SYMMETRIC STORAGE MODE - HIGH ACCURACY SOLUTION

LLBQF SOLUTION OF LINEAR LEAST SQUARES - HIGH ACCURACY

LQSQF SOLUTION OF A LINEAR LEAST SQUARES PROBLEM

LSVDB SINGULAR VALUE DECOMPOSITION OF A BIDIAGONAL MATRIX

LSVDF SINGULAR VALUE DECOMPOSITION OF A REAL MATRIX

LUDAPB DECOMPOSITION OF A POSITIVE DEFINITE BAND SYMMETRIC MATRIX -  
BAND SYMMETRIC STORAGE MODE

LUDATF L-U DECOMPOSITION BY THE CROUT ALGORITHM WITH OPTIONAL  
ACCURACY TEST

LUDECP DECOMPOSITION OF A POSITIVE DEFINITE MATRIX - SYMMETRIC  
STORAGE MODE

LUELMF ELIMINATION PART OF SOLUTION OF  $AX=B$  (FULL STORAGE MODE)

LUELMP ELIMINATION PART OF THE SOLUTION OF  $AX=B$  - POSITIVE DEFINITE  
MATRIX - SYMMETRIC STORAGE MODE

LUELPB ELIMINATION PART OF SOLUTION OF  $AX=B$  - POSITIVE DEFINITE BAND  
SYMMETRIC MATRIX - BAND SYMMETRIC STORAGE MODE

LUREFF REFINEMENT OF SOLUTION TO LINEAR EQUATIONS - FULL STORAGE  
MODE

LUREFP REFINEMENT OF SOLUTION TO LINEAR EQUATIONS - POSITIVE  
DEFINITE MATRIX - SYMMETRIC STORAGE MODE

LUREPB REFINEMENT OF SOLUTION TO LINEAR EQUATIONS - POSITIVE  
DEFINITE BAND SYMMETRIC MATRIX - BAND SYMMETRIC STORAGE MODE

MDBETA BETA PROBABILITY DISTRIBUTION FUNCTION

MDBETI INVERSE BETA PROBABILITY DISTRIBUTION FUNCTION

MDBIN BINOMIAL PROBABILITY DISTRIBUTION FUNCTION

MDBNOR BIVARIATE NORMAL PROBABILITY DISTRIBUTION FUNCTION

MDCH CHI-SQUARED PROBABILITY DISTRIBUTION FUNCTION

MDCHI	INVERSE CHI-SQUARED PROBABILITY DISTRIBUTION FUNCTION
MDCHN	NON-CENTRAL CHI-SQUARED PROBABILITY DISTRIBUTION FUNCTION
MDFD	F PROBABILITY DISTRIBUTION FUNCTION
MDFDRE	F PROBABILITY DISTRIBUTION FUNCTION (INTEGER OR FRACTIONAL DEGREES OF FREEDOM)
MDFI	INVERSE F PROBABILITY DISTRIBUTION FUNCTION
MDGAM	GAMMA PROBABILITY DISTRIBUTION FUNCTION
MDGC	GENERAL CONTINUOUS PROBABILITY DISTRIBUTION FUNCTION
MDGCI	INVERSE OF GENERAL CONTINUOUS PROBABILITY DISTRIBUTION FUNCTION
MDHYP	HYPERGEOMETRIC PROBABILITY DISTRIBUTION FUNCTION
MDNOR	NORMAL OR GAUSSIAN PROBABILITY DISTRIBUTION FUNCTION
MDNRIS	INVERSE STANDARD NORMAL (GAUSSIAN) PROBABILITY DISTRIBUTION FUNCTION
MDSMR	KOLMOGOROV-SMIRNOV STATISTICS ASYMPTOTIC PROBABILITY DISTRIBUTION FUNCTION
MDSTI	INVERSE OF A MODIFICATION OF STUDENTS T PROBABILITY DISTRIBUTION FUNCTION
MDTD	STUDENTS T PROBABILITY DISTRIBUTION FUNCTION
MDTN	NON-CENTRAL T PROBABILITY DISTRIBUTION FUNCTION
MDTNF	INTEGRAL RELATED TO CALCULATION OF NON-CENTRAL T AND BIVARIATE NORMAL PROBABILITY DISTRIBUTION FUNCTIONS
MDTPS	CUMULATIVE PROBABILITY AND, OPTIONALLY, INDIVIDUAL TERMS OF THE POISSON PROBABILITY DISTRIBUTION FUNCTION
MERFCI	INVERSE COMPLEMENTED ERROR FUNCTION
MERFI	INVERSE ERROR FUNCTION
MMBSI	MODIFIED BESSEL FUNCTION OF THE FIRST KIND OF ORDER ZERO
MMBSI1	MODIFIED BESSEL FUNCTION OF THE FIRST KIND OF ORDER ONE
MMBSJ	BESSEL FUNCTION OF THE FIRST KIND OF ORDER ZERO
MMBSJ1	BESSEL FUNCTION OF THE FIRST KIND OF ORDER ONE
MMBSK	MODIFIED BESSEL FUNCTION OF THE SECOND KIND OF ORDER ZERO



MMBSK1	MODIFIED BESSEL FUNCTION OF THE SECOND KIND OF ORDER ONE
MMBSYN	BESSEL FUNCTION OF THE SECOND KIND OF NON- NEGATIVE REAL FRACTIONAL ORDER FOR REAL POSITIVE ARGUMENTS
MMDAS	DAWSON INTEGRAL
MMDEI	EXPONENTIAL INTEGRALS
MMDELE	COMPLETE ELLIPTIC INTEGRAL OF THE SECOND KIND
MMDELK	COMPLETE ELLIPTIC INTEGRAL OF THE FIRST KIND
MMKELD	DERIVATIVES OF THE KELVIN FUNCTIONS (BER,BEI, KER, AND KEI) OF ORDER ZERO
MMKEL	KELVIN FUNCTIONS OF THE FIRST KIND, (BER,BEI), AND OF THE SECOND KIND, (KER,KEI), OF ORDER ZERO
MMKEL1	KELVIN FUNCTIONS OF THE FIRST KIND, (BER,BEI), AND OF THE SECOND KIND, (KER,KEI), OF ORDER ONE
MMPSI	LOGARITHMIC DERIVATIVE OF THE GAMMA FUNCTION
MSMRAT	RATIO OF THE ORDINATE TO THE UPPER TAIL AREA OF THE STANDARDIZED NORMAL (GAUSSIAN) DISTRIBUTION
NAK1	KRUSKAL-WALLIS TEST FOR IDENTICAL POPULATIONS
NAWNRP	WILSONS ANOVA (2 OR 3 WAY DESIGNS) WITHOUT REPLICATES
NAWRPE	WILSONS ANOVA (1, 2, OR 3 WAY DESIGNS) WITH EQUAL REPLICATION
NAWRPU	WILSONS ANOVA (1, 2, OR 3 WAY DESIGNS) WITH UNEQUAL REPLICATION
NBCYC	NOETHERS TEST FOR CYCLICAL TREND
NBQT	COCHRAN Q TEST
NBSDL	COX AND STUART SIGN TEST FOR TRENDS IN DISPERSION AND LOCATION
NBSIGN	SIGN TEST (FOR PERCENTILES)
NDEST	EVALUATE PROBABILITY DENSITY FUNCTION AT SPECIFIED POINTS
NDKER	NONPARAMETRIC PROBABILITY DENSITY FUNCTION (ONE DIMENSIONAL) ESTIMATION BY KERNEL METHOD
NDMPLE	NONPARAMETRIC PROBABILITY DENSITY FUNCTION (ONE DIMENSIONAL) ESTIMATION BY PENALIZED LIKELIHOOD METHOD
NHEXT	FISHERS EXACT METHOD FOR 2 BY 2 TABLES
NHINC	INCLUDANCE TEST

NKS1 KOLMOGOROV-SMIRNOV ONE-SAMPLE TEST

NKS2 KOLMOGOROV-SMIRNOV TWO-SAMPLE TEST

NMCC CALCULATE AND TEST THE SIGNIFICANCE OF THE KENDALL COEFFICIENT OF CONCORDANCE

NMKEN KENDALLS TEST FOR CORRELATION (RANK CORRELATION COEFFICIENT)

NMKSF FREQUENCY DISTRIBUTION OF K AND THE PROBABILITY OF EQUALLING OR EXCEEDING K, WHERE K, THE TOTAL SCORE FROM THE KENDALL RANK CORRELATION COEFFICIENT CALCULATIONS, AND N, THE SAMPLE SIZE, ARE GIVEN

NMKT5 K-SAMPLE TRENDS TEST AGAINST ORDERED ALTERNATIVES

NMRANK NUMERICAL RANKING

NMTIE TIE STATISTICS, GIVEN A SAMPLE OF OBSERVATIONS

NRBHA BHAPKAR V TEST

NRWMD WILCOXON SIGNED RANK TEST

NRWRST WILCOXONS RANK-SUM TEST

OCDIS PAIRWISE EUCLIDEAN DISTANCE BETWEEN COLUMNS OF A MATRIX

OCLINK PERFORM A SINGLE-LINKAGE OR COMPLETE-LINKAGE HIERARCHICAL CLUSTER ANALYSIS GIVEN A SIMILARITY MATRIX

ODFISH LINEAR DISCRIMINANT ANALYSIS METHOD OF FISHER FOR REDUCING THE NUMBER OF VARIABLES

ODNORM MULTIVARIATE NORMAL LINEAR DISCRIMINANT ANALYSIS AMONG SEVERAL KNOWN GROUPS

OFCOEF COMPUTE A MATRIX OF FACTOR SCORE COEFFICIENTS FOR INPUT TO IMSL ROUTINE OFSCOR

OFCOMM COMPUTE AN UNROTATED FACTOR LOADING MATRIX ACCORDING TO A COMMON FACTOR MODEL BY UNWEIGHTED OR GENERALIZED LEAST SQUARES, OR BY MAXIMUM LIKELIHOOD PROCEDURES

OFHARR TRANSFORMATION OF UNROTATED FACTOR LOADING MATRIX TO OBLIQUE AXES BY HARRIS-KAISER METHOD

OFIMAG COMPUTE AN UNROTATED FACTOR LOADING MATRIX ACCORDING TO AN IMAGE MODEL

OFIMA3 LEAST SQUARES SOLUTION TO THE MATRIX EQUATION  $AT = B$

OFPRI COMPUTE AN UNROTATED FACTOR LOADING MATRIX ACCORDING TO A PRINCIPAL COMPONENT MODEL

OFPROT     OBLIQUE TRANSFORMATION OF THE FACTOR LOADING MATRIX USING A  
            TARGET MATRIX, INCLUDING PIVOT AND POWER VECTOR OPTIONS

OFRESI     COMMUNALITIES AND NORMALIZED FACTOR RESIDUAL CORRELATION  
            MATRIX CALCULATION

OFROTA     ORTHOGONAL ROTATION OF A FACTOR LOADING MATRIX USING A  
            GENERALIZED ORTHOMAX CRITERION, INCLUDING QUARTIMAX, VARIMAX,  
            AND EQUAMAX

OFSCHN     ORTHOGONAL TRANSFORMATION OF THE FACTOR LOADING MATRIX USING  
            A TARGET MATRIX

OFSCOR     COMPUTE A SET OF FACTOR SCORES GIVEN THE FACTOR SCORE  
            COEFFICIENT MATRIX

OIND       WILKS TEST FOR THE INDEPENDENCE OF K SETS OF MULTI-NORMAL  
            VARIATES

OPRINC     PRINCIPAL COMPONENTS OF A MULTIVARIATE SAMPLE OF OBSERVATIONS

OTMLNR     MAXIMUM LIKELIHOOD ESTIMATION FROM GROUPED AND/OR CENSORED  
            NORMAL DATA

RLCOMP     GENERATION OF AN ORTHOGONAL CENTRAL COMPOSITE DESIGN

RLDCQM     DECODING OF A QUADRATIC REGRESSION MODEL

RLDCVA     VARIANCE ESTIMATES FOR DECODED ORTHOGONAL POLYNOMIAL  
            REGRESSION COEFFICIENTS

RLDCW     VARIANCES OF CODED ORTHOGONAL POLYNOMIAL REGRESSION  
            COEFFICIENTS. FOR USAGE IN CONJUNCTION WITH IMSL ROUTINES  
            RLFOTH AND RLFOTW, AND PROVIDED TO PREPARE INPUT FOR IMSL  
            ROUTINE RLDCVA.

RLDOPM     COEFFICIENT DECODER FOR AN ORTHOGONAL POLYNOMIAL REGRESSION  
            MODEL

RLEAP     LEAPS AND BOUNDS ALGORITHM FOR DETERMINING A NUMBER OF BEST  
            REGRESSION SUBSETS FROM A FULL REGRESSION MODEL

RLFITI     PURE REPLICATION ERROR DEGREES OF FREEDOM AND SUM OF SQUARES  
            (IN-CORE VERSION)

RLFITO     PURE REPLICATION ERROR DEGREES OF FREEDOM AND SUM OF SQUARES  
            (OUT-OF-CORE VERSION)

RLFOR     FIT A UNIVARIATE CURVILINEAR REGRESSION MODEL USING  
            ORTHOGONAL POLYNOMIALS WITH OPTIONAL WEIGHTING (EASY TO USE  
            VERSION)

RLFOTH     FIT A UNIVARIATE CURVILINEAR REGRESSION MODEL USING  
            ORTHOGONAL POLYNOMIALS

RLFOTW FIT A UNIVARIATE CURVILINEAR REGRESSION MODEL USING  
ORTHOGONAL POLYNOMIALS WITH WEIGHTING

RLGQMI CENTERING OF INDEPENDENT VARIABLE SETTINGS AND GENERATION OF  
CENTERED SQUARE AND CROSS PRODUCT TERMS (IN-CORE VERSION)

RLGQMO CENTERING OF INDEPENDENT VARIABLE SETTINGS AND GENERATION OF  
UNCENTERED SQUARE AND CROSS PRODUCT TERMS (OUT-OF-CORE  
VERSION)

RLINCF RESPONSE CONTROL USING A FITTED SIMPLE LINEAR REGRESSION  
MODEL

RLINPF INVERSE PREDICTION USING A FITTED SIMPLE LINEAR REGRESSION  
MODEL

RLLAV LINEAR REGRESSION USING LEAST ABSOLUTE VALUES CRITERION

RRLMV LINEAR REGRESSION USING LEAST MINIMAX

RLMUL MULTIPLE LINEAR REGRESSION ANALYSIS

RLONE ANALYSIS OF A SIMPLE LINEAR REGRESSION MODEL

RLOPDC RESPONSE PREDICTION USING AN ORTHOGONAL POLYNOMIAL REGRESSION  
MODEL

RLPOL GENERATE ORTHOGONAL POLYNOMIALS WITH THE ASSOCIATED CONSTANTS  
AA AND BB

RLPRDI CONFIDENCE INTERVALS FOR THE TRUE RESPONSE AND FOR THE  
AVERAGE OF A SET OF FUTURE OBSERVATIONS ON THE RESPONSE (IN-  
CORE VERSION)

RLPRDO CONFIDENCE INTERVALS FOR THE TRUE RESPONSE AND FOR THE  
AVERAGE OF A SET OF FUTURE OBSERVATIONS ON THE RESPONSE (OUT-  
OF-CORE VERSION)

RLRES PERFORM A RESIDUAL ANALYSIS FOR A FITTED REGRESSION MODEL

RLSEP SELECTION OF A REGRESSION MODEL USING A FORWARD STEPWISE  
ALGORITHM, AND COMPUTATION OF THE USUAL ANALYSIS OF VARIANCE  
TABLE ENTRIES - EASY TO USE VERSION

RLSTP REGRESSION MODEL SELECTION USING A FORWARD STEPWISE ALGORITHM  
WITH RESULTS AVAILABLE AFTER EACH STEP

RLSUBM RETRIEVAL OF A SYMMETRIC SUBMATRIX FROM A MATRIX STORED IN  
SYMMETRIC STORAGE MODE BY RLSTP

RLSUM REORDERING OF THE ROWS AND CORRESPONDING COLUMNS OF A  
SYMMETRIC MATRIX STORED IN SYMMETRIC STORAGE MODE

RSMITZ LEAST SQUARES FIT OF THE NON-LINEAR REGRESSION MODEL  $Y(I) =$   
 $ALPHA + BETA * GAMMA ** X(I) + E(I)$

SASUM COMPUTE SINGLE PRECISION SUM OF ABSOLUTE VALUES (VBLA=SASUM)

SAXPY COMPUTE A CONSTANT TIMES A VECTOR PLUS A VECTOR, ALL SINGLE PRECISION (VBLA=SAXPY)

SCASUM COMPUTE COMPLEX SUM OF ABSOLUTE VALUES (VBLA=SCASUM)

SCNRM2 COMPUTE THE EUCLIDEAN LENGTH OR L2 NORM OF A COMPLEX VECTOR (VBLA=SCNRM2)

SCOPY COPY A VECTOR X TO A VECTOR Y, BOTH SINGLE PRECISION (VBLA=SCOPY)

SDOT COMPUTE SINGLE PRECISION DOT PRODUCT (VBLA=SDOT)

SDSDOT COMPUTE SINGLE PRECISION DOT PRODUCT AND ADD A CONSTANT USING DOUBLE PRECISION ACCUMULATION (VBLA=SDSDOT)

SNRM2 COMPUTE THE EUCLIDEAN LENGTH OR L2 NORM OF A SINGLE PRECISION VECTOR (VBLA=SNRM2)

SROT APPLY GIVENS PLANE ROTATION (SINGLE PRECISION) (VBLA=SROT)

SROTG CONSTRUCT GIVENS PLANE ROTATION (SINGLE PRECISION) (VBLA=SROTG)

SROTM APPLY A MODIFIED GIVENS PLANE ROTATION (SINGLE PRECISION) (VBLA=SROTM)

SROTMG CONSTRUCT A MODIFIED GIVENS PLANE ROTATION (SINGLE PRECISION) (VBLA=SROTMG)

SSCAL COMPUTE A SINGLE PRECISION CONSTANT TIMES A SINGLE PRECISION VECTOR (VBLA=SSCAL)

SSPAND SIMPLE RANDOM SAMPLING WITH PROPORTION DATA-INFERENCES REGARDING THE POPULATION PROPORTION AND TOTAL

SSPBLK STRATIFIED RANDOM SAMPLING WITH PROPORTION DATA - INFERENCES REGARDING THE POPULATION PROPORTION AND TOTAL

SSRAND SIMPLE RANDOM SAMPLING WITH CONTINUOUS DATA - INFERENCES REGARDING THE POPULATION MEAN AND TOTAL USING RATIO OR REGRESSION ESTIMATION

SSRBLK STRATIFIED RANDOM SAMPLING WITH CONTINUOUS DATA-INFERENCES REGARDING THE POPULATION MEAN AND TOTAL USING RATIO OR REGRESSION ESTIMATION

SSSAND SIMPLE RANDOM SAMPLING WITH CONTINUOUS DATA - INFERENCES REGARDING THE POPULATION MEAN AND TOTAL

SSSBLK STRATIFIED RANDOM SAMPLING WITH CONTINUOUS DATA - INFERENCES REGARDING THE POPULATION MEAN AND TOTAL

SSSCAN SINGLE STAGE CLUSTER SAMPLING WITH CONTINUOUS DATA -  
INFERENCES REGARDING THE POPULATION MEAN AND TOTAL

SSSEST TWO-STAGE SAMPLING WITH CONTINUOUS DATA AND EQUISIZED PRIMARY  
UNITS - INFERENCES REGARDING THE POPULATION MEAN AND TOTAL

SSWAP INTERCHANGE VECTORS X AND Y, BOTH SINGLE PRECISION  
(VBLA=SSWAP)

UERSET SET MESSAGE LEVEL FOR IMSL ROUTINE UERTST

UERTST PRINT A MESSAGE REFLECTING AN ERROR CONDITION

UGETIO TO RETRIEVE CURRENT VALUES AND TO SET NEW VALUES FOR INPUT  
AND OUTPUT UNIT IDENTIFIERS

UHELP DISPLAY METHODS OF OBTAINING INFORMATION ON IMSL CONVENTIONS  
REGARDING VARIOUS SUBJECTS AND PROVIDE A MEANS FOR INDIVIDUAL  
SITES TO SUPPLY USERS WITH SITE SPECIFIC INFORMATION

UHELP1 WRITE INFORMATION REGARDING IMSL CONVENTIONS AND NOTATION TO  
AN OUTPUT FILE

UHELP2 WRITE INFORMATION REGARDING IMSL INPUT AND OUTPUT CONVENTIONS

UHELP3 WRITE INFORMATION REGARDING IMSL ERROR DETECTING FACILITIES

UHELP4 WRITE INFORMATION REGARDING MATRIX/VECTOR STORAGE MODES USED  
IN IMSL SUBROUTINES

USBOX PRINT BOXPLOT

USCRDM READ A MATRIX (OPTIONAL SEQUENCE CHECK)

USHIST PRINT A HISTOGRAM (VERTICAL)

USHIUT PRINT A HISTOGRAM, PLOTTING TWO FREQUENCIES WITH ONE BAR OF  
THE HISTOGRAM (VERTICAL)

USHV1 PRINT A HISTOGRAM (HORIZONTAL)

USLEAP PRINT RESULTS OF THE BEST-REGRESSIONS ANALYSIS PERFORMED BY  
IMSL ROUTINE RLEAP

USNMIX DETERMINATION OF THE MINIMUM AND MAXIMUM VALUES OF A VECTOR

USPC PRINT A SAMPLE PDF, A THEORETICAL PDF AND CONFIDENCE BAND  
INFORMATION WITH OPTIONAL PLOT

USPDF PLOT OF TWO SAMPLE PROBABILITY DISTRIBUTION FUNCTIONS AGAINST  
THEIR SPECTRA

USPLT PRINTER PLOT OF UP TO TEN FUNCTIONS

USRDM READ A MATRIX

USRDV	READ A VECTOR
USSLF	PRINT STEM AND LEAF DISPLAY
USTREE	PRINT A BINARY TREE (WHICH MAY REPRESENT THE OUTPUT OF A CLUSTERING ALGORITHM IN CHAPTER O)
USWBM	PRINT A MATRIX STORED IN BAND STORAGE MODE
USWBS	PRINT A MATRIX STORED IN BAND SYMMETRIC STORAGE MODE
USWFM	PRINT A MATRIX STORED IN FULL STORAGE MODE
USWFO	PRINT A VECTOR
USWSM	PRINT A MATRIX STORED IN SYMMETRIC STORAGE MODE
VABMXF	MAXIMUM ABSOLUTE VALUE OF THE ELEMENTS OF A VECTOR OR A SUBSET OF THE ELEMENTS OF A VECTOR (FULL STORAGE MODE)
VABMXS	MAXIMUM ABSOLUTE VALUE OF THE ELEMENTS OF A ROW OR COLUMN OF A MATRIX STORED (SYMMETRIC STORAGE MODE)
VABSMF	SUM OF THE ABSOLUTE VALUES OF THE ELEMENTS OF A VECTOR OR A SUBSET OF A VECTOR (FULL STORAGE MODE)
VABSMS	SUM OF THE ABSOLUTE VALUES OF THE ELEMENTS OF A ROW (OR COLUMN) OF A MATRIX STORED (SYMMETRIC STORAGE MODE)
VBLA	PACKAGE OF 38 LINEAR ALGEBRA ROUTINES
VCONVO	VECTOR CONVOLUTION
VCVTBF	STORAGE MODE CONVERSION OF MATRICES (BAND TO FULL STORAGE MODE)
VCVTCH	STORAGE MODE CONVERSION OF MATRICES (FULL COMPLEX TO HERMITIAN)
VCVTFB	STORAGE MODE CONVERSION OF MATRICES (FULL TO BAND STORAGE MODE)
VCVTFQ	STORAGE MODE CONVERSION (FULL TO BAND SYMMETRIC STORAGE MODE)
VCVTFS	STORAGE MODE CONVERSION OF MATRICES (FULL TO SYMMETRIC)
VCVTHC	STORAGE MODE CONVERSION OF MATRICES (HERMITIAN TO FULL COMPLEX)
VCVTQF	STORAGE MODE CONVERSION (BAND SYMMETRIC TO FULL STORAGE MODE)
VCVTQS	STORAGE MODE CONVERSION (BAND SYMMETRIC TO SYMMETRIC STORAGE MODE)
VCVTSF	STORAGE MODE CONVERSION OF MATRICES (SYMMETRIC TO FULL)

VCVTSQ	STORAGE MODE CONVERSION (SYMMETRIC TO BAND SYMMETRIC STORAGE MODE)
VDCPS	DECOMPOSE AN INTEGER INTO ITS PRIME FACTORS
VHSH2C	COMPLEX HOUSEHOLDER TRANSFORMATION TO ZERO A SINGLE ELEMENT OF A MATRIX
VHSH2R	REAL HOUSEHOLDER TRANSFORMATION TO ZERO A SINGLE ELEMENT OF A MATRIX
VHSH3R	REAL HOUSEHOLDER TRANSFORMATION TO ZERO TWO ELEMENTS OF A MATRIX
VHS12	REAL HOUSEHOLDER TRANSFORMATION - COMPUTATION AND APPLICATIONS
VIPRFF	VECTOR INNER PRODUCT OF TWO VECTORS OR SUBSETS OF TWO VECTORS
VIPRSS	VECTOR INNER PRODUCT OF TWO VECTORS EACH OF WHICH IS PART OF SOME MATRIX STORED IN SYMMETRIC MODE
VMULBB	MATRIX MULTIPLICATION (BAND STORAGE MODE)
VMULBF	MATRIX MULTIPLICATION (BAND BY FULL MATRICES)
VMULBS	MATRIX MULTIPLICATION (BAND BY SYMMETRIC
VMULFB	MATRIX MULTIPLICATION (FULL BY BAND MATRICES)
VMULFF	MATRIX MULTIPLICATION (FULL STORAGE MODE)
VMULFM	MATRIX MULTIPLICATION OF THE TRANSPOSE OF MATRIX A BY MATRIX B (FULL STORAGE MODE)
VMULFP	MATRIX MULTIPLICATION OF MATRIX A BY THE TRANSPOSE OF MATRIX B (FULL STORAGE MODE)
VMULFQ	MATRIX MULTIPLICATION (FULL BY BAND SYMMETRIC MATRICES)
VMULFS	MATRIX MULTIPLICATION (FULL BY SYMMETRIC MATRICES)
VMULQB	MATRIX MULTIPLICATION (BAND SYMMETRIC BY BAND MATRICES)
VMULQF	MATRIX MULTIPLICATION (BAND SYMMETRIC BY FULL MATRICES)
VMULQQ	MATRIX MULTIPLICATION (BAND SYMMETRIC STORAGE MODE)
VMULQS	MATRIX MULTIPLICATION (BAND SYMMETRIC BY SYMMETRIC MATRICES)
VMULSB	MATRIX MULTIPLICATION (SYMMETRIC BY BAND MATRICES)
VMULSF	MATRIX MULTIPLICATION (SYMMETRIC BY FULL MATRICES)
VMULSQ	MATRIX MULTIPLICATION (SYMMETRIC BY BAND SYMMETRIC MATRICES)



VMULSS	MATRIX MULTIPLICATION (SYMMETRIC STORAGE MODE)
VNRMF1	INFINITY-NORM MATRICES (FULL STORAGE MODE)
VNRMF1	1-NORM OF MATRICES (FULL STORAGE MODE)
VNRMF2	EUCLIDEAN-NORM OF MATRICES (FULL STORAGE MODE)
VNRMS1	1-NORM OF MATRICES (SYMMETRIC STORAGE MODE)
VNRMS2	EUCLIDEAN-NORM OF MATRICES (SYMMETRIC STORAGE MODE)
VPOLYF	MATRIX POLYNOMIAL (FULL STORAGE MODE)
VSRTA	SORTING OF ARRAYS BY ALGEBRAIC VALUE
VSRTM	SORTING OF ARRAYS BY ABSOLUTE VALUE
VS RTP	SORTING OF ARRAYS BY ABSOLUTE VALUE - PERMUTATIONS RETURNED
VS RTR	SORTING OF ARRAYS BY ALGEBRAIC VALUE - PERMUTATIONS RETURNED
VS RTU	INTERCHANGE THE ROWS OR COLUMNS OF A MATRIX USING A PERMUTATION VECTOR SUCH AS THE ONE OBTAINED FROM IMSL ROUTINES VS RTP OR VS RTR
VT PROF	TRANSPOSE PRODUCT OF MATRIX (FULL STORAGE MODE)
VT PROS	TRANSPOSE PRODUCT OF A MATRIX (SYMMETRIC STORAGE MODE)
VTRAN	TRANSPOSE A RECTANGULAR MATRIX
VUABQ	MATRIX ADDITION (BAND + BAND SYMMETRIC MATRICES)
VUA FB	MATRIX ADDITION (FULL + BAND MATRICES)
VUA FQ	MATRIX ADDITION (FULL + BAND SYMMETRIC MATRICES)
VUA FS	MATRIX ADDITION (FULL + SYMMETRIC MATRICES)
VUA SB	MATRIX ADDITION (SYMMETRIC + BAND MATRICES)
VUA SQ	MATRIX ADDITION (SYMMETRIC + BAND SYMMETRIC MATRICES)
ZANLYT	ZEROS OF AN ANALYTIC COMPLEX FUNCTION USING THE MULLER METHOD WITH DEFLATION
ZBRENT	ZERO OF A FUNCTION WHICH CHANGES SIGN IN A GIVEN INTERVAL (BRENT ALGORITHM)
ZCPOLY	ZEROS OF A POLYNOMIAL WITH COMPLEX COEFFICIENTS (JENKINS-TRAUB)
ZFALSE	ZERO OF A FUNCTION GIVEN AN INTERVAL CONTAINING THE ZERO

ZPOLR      ZEROS OF A POLYNOMIAL WITH REAL COEFFICIENTS (LAGUERRE)

ZQADC      ZEROS OF A QUADRATIC WITH COMPLEX COEFFICIENTS

ZQADR      ZEROS OF A QUADRATIC WITH REAL COEFFICIENTS

ZREAL1     THE REAL ZEROS OF A REAL FUNCTION - TO BE USED WHEN INITIAL  
             GUESSES ARE POOR

ZREAL2     THE REAL ZEROS OF A REAL FUNCTION - TO BE USED WHEN INITIAL  
             GUESSES ARE GOOD

ZRPOLY     ZEROS OF A POLYNOMIAL WITH REAL COEFFICIENTS (JENKINS-TRAUB)

ZSCNT      SOLVE SYSTEM OF NONLINEAR EQUATIONS BY SECANT METHOD

ZSRCH      GENERATE POINTS IN AN N DIMENSIONAL SPACE

ZSYSTEM    DETERMINATION OF A ROOT OF A SYSTEM OF N SIMULTANEOUS  
             NONLINEAR EQUATIONS IN N UNKNOWN

ZXCGR      A CONJUGATE GRADIENT ALGORITHM FOR FINDING THE MINIMUM OF A  
             FUNCTION OF N VARIABLES

ZXGSN      ONE-DIMENSIONAL UNIMODAL FUNCTION MINIMIZATION USING THE  
             GOLDEN SECTION SEARCH METHOD

ZXGSP      ONE-DIMENSIONAL UNIMODAL FUNCTION MINIMIZATION USING THE  
             GOLDEN SECTION SEARCH METHOD - DATA PARAMETERS SPECIFIED

ZXMIN      MINIMUM OF A FUNCTION OF N VARIABLES USING A QUASI-NEWTON  
             METHOD

ZXSSQ      MINIMUM OF THE SUM OF SQUARES OF M FUNCTIONS IN N VARIABLES  
             USING A FINITE DIFFERENCE LEVENBERG-MARQUARDT ALGORITHM

ZX0LP      SOLVE THE LINEAR PROGRAMMING PROBLEM (PHASE ONE OR PHASE TWO)  
             VIA THE REVISED SIMPLEX ALGORITHM

ZX3LP      SOLVE THE LINEAR PROGRAMMING PROBLEM VIA THE REVISED SIMPLEX  
             ALGORITHM (EASY TO USE VERSION)

ZX4LP      SOLVE THE LINEAR PROGRAMMING PROBLEM VIA THE REVISED SIMPLEX  
             ALGORITHM USING ORTHOGONAL DECOMPOSITION (EASY TO USE  
             VERSION)

## LINPACK

LINPACK IS A PACKAGE OF 40 SUBROUTINES TO ANALYZE AND SOLVE VARIOUS CLASSES OF SYSTEMS OF SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS WHICH WAS OBTAINED FROM ARGONNE NATIONAL LABORATORY. BESIDE THE SINGLE PRECISION PACKAGE VERSIONS FOR COMPLEX OR DOUBLE PRECISION EXIST. ROUTINES ARE INCLUDED FOR GENERAL, Banded, SYMMETRIC INDEFINITE, SYMMETRIC POSITIVE DEFINITE, TRIANGULAR, AND TRIDIAGONAL SQUARE MATRICES PLUS LEAST SQUARE PROBLEMS AND QR AND SINGLE VALUE DECOMPOSITIONS OF RECTANGULAR MATRICES. THE PACKAGE ALSO INCLUDES 11 BASIC LINEAR ALGEBRA SUBPROGRAMS.

REFERENCE: "LINPACK USERS' GUIDE", J. J. DONGARA, J. R. BUNCH, C. D. MOLER, G. W. STEWART, SIAM, 1979.

## ROUTINES IN LIBRARY 'LINPACK' INCLUDE:

SCHDC	COMPUTES THE CHOLESKY DECOMPOSITION OF A POSITIVE DEFINITE MATRIX. A PIVOTING OPTION ALLOWS THE USER TO ESTIMATE THE CONDITION OF A POSITIVE DEFINITE MATRIX OR DETERMINE THE RANK OF A POSITIVE SEMIDEFINITE MATRIX.
SCHDD	DOWNDATES AN AUGMENTED CHOLESKY DECOMPOSITION OR THE TRIANGULAR FACTOR OF AN AUGMENTED QR DECOMPOSITION.
SCHEX	UPDATES THE CHOLESKY FACTORIZATION $A = \text{TRANS}(R) * R$ OF A POSITIVE DEFINITE MATRIX A OF ORDER P UNDER DIAGONAL PERMUTATIONS OF THE FORM $\text{TRANS}(E) * A * E$ WHERE E IS A PERMUTATION MATRIX.
SCHUD	UPDATES AN AUGMENTED CHOLESKY DECOMPOSITION OF THE TRIANGULAR PART OF AN AUGMENTED QR DECOMPOSITION.
SGBCO	FACTORS A REAL BAND MATRIX BY GAUSSIAN ELIMINATION AND ESTIMATES THE CONDITION OF THE MATRIX.
SGBDI	COMPUTES THE DETERMINANT OF A BAND MATRIX USING THE FACTORS COMPUTED BY SGBCO OR SGBFA.
SGBFA	FACTORS A REAL BAND MATRIX BY ELIMINATION.
SGBSL	SOLVES THE REAL BAND SYSTEM $A * X = B$ OR $\text{TRANS}(A) * X = B$ USING THE FACTORS COMPUTED BY SGBCO OR SGBFA.
SGECO	FACTORS A REAL MATRIX BY GAUSSIAN ELIMINATION AND ESTIMATES THE CONDITION OF THE MATRIX.
SGEDI	COMPUTES THE DETERMINANT AND INVERSE OF A MATRIX USING THE FACTORS COMPUTED BY SGECO OR SGEFA.
SGEFA	FACTORS A REAL MATRIX BY GAUSSIAN ELIMINATION.

SGESL SOLVES THE REAL SYSTEM  $A * X = B$  OR  $TRANS(A) * X = B$  USING THE FACTORS COMPUTED BY SGECO OR SGEFA.

SGTSL GIVEN A GENERAL TRIDIAGONAL MATRIX AND A RIGHT HAND SIDE WILL FIND THE SOLUTION.

SPBCO FACTORS A REAL SYMMETRIC POSITIVE DEFINITE MATRIX STORED IN

SPBDI COMPUTES THE DETERMINANT OF A REAL SYMMETRIC POSITIVE DEFINITE BAND MATRIX USING THE FACTORS COMPUTED BY SPBCO OR SPBFA.

SPBFA FACTORS A REAL SYMMETRIC POSITIVE DEFINITE MATRIX STORED IN BAND FORM.

SPBSL SOLVES THE REAL SYMMETRIC POSITIVE DEFINITE BAND SYSTEM  $A * X = B$  USING THE FACTORS COMPUTED BY SPBCO OR SPBFA.

SPOCO FACTORS A REAL SYMMETRIC POSITIVE DEFINITE MATRIX AND ESTIMATES THE CONDITION OF THE MATRIX.

SPODI COMPUTES THE DETERMINANT AND INVERSE OF A CERTAIN REAL SYMMETRIC POSITIVE DEFINITE MATRIX (SEE BELOW) USING THE FACTORS COMPUTED BY SPOCO, SPOFA OR SQRDC.

SPOFA FACTORS A REAL SYMMETRIC POSITIVE DEFINITE MATRIX.

SPOSL SOLVES THE REAL SYMMETRIC POSITIVE DEFINITE SYSTEM  $A * X = B$  USING THE FACTORS COMPUTED BY SPOCO OR SPOFA.

SPPCO FACTORS A REAL SYMMETRIC POSITIVE DEFINITE MATRIX STORED IN PACKED FORM AND ESTIMATES THE CONDITION OF THE MATRIX.

SPPDI COMPUTES THE DETERMINANT AND INVERSE OF A REAL SYMMETRIC POSITIVE DEFINITE MATRIX USING THE FACTORS COMPUTED BY SPPCO OR SPPFA.

SPPFA FACTORS A REAL SYMMETRIC POSITIVE DEFINITE MATRIX STORED IN PACKED FORM.

SPPSL SOLVES THE REAL SYMMETRIC POSITIVE DEFINITE SYSTEM  $A * X = B$  USING THE FACTORS COMPUTED BY SPPCO OR SPPFA.

SPTSL GIVEN A POSITIVE DEFINITE TRIDIAGONAL MATRIX AND A RIGHT HAND SIDE WILL FIND THE SOLUTION.

SQRDC USES HOUSEHOLDER TRANSFORMATIONS TO COMPUTE THE QR FACTORIZATION OF AN N BY P MATRIX X. COLUMN PIVOTING BASED ON THE 2-NORMS OF THE REDUCED COLUMNS MAY BE PERFORMED AT THE USERS OPTION.

SQRS� APPLIES THE OUTPUT OF SQRDC TO COMPUTE COORDINATE TRANSFORMATIONS, PROJECTIONS, AND LEAST SQUARES SOLUTIONS.

SSICO FACTORS A REAL SYMMETRIC MATRIX BY ELIMINATION WITH SYMMETRIC PIVOTING AND ESTIMATES THE CONDITION OF THE MATRIX.

SSIDI COMPUTES THE DETERMINANT, INERTIA AND INVERSE OF A REAL SYMMETRIC MATRIX USING THE FACTORS FROM SSIFA.

SSIFA FACTORS A REAL SYMMETRIC MATRIX BY ELIMINATION WITH SYMMETRIC PIVOTING.

SSISL SOLVES THE REAL SYMMETRIC SYSTEM  $A * X = B$  USING THE FACTORS COMPUTED BY SSIFA.

SSPCO FACTORS A REAL SYMMETRIC MATRIX STORED IN PACKED FORM BY ELIMINATION WITH SYMMETRIC PIVOTING AND ESTIMATES THE CONDITION OF THE MATRIX.

SSPDI COMPUTES THE DETERMINANT, INERTIA AND INVERSE OF A REAL SYMMETRIC MATRIX USING THE FACTORS FROM SSPFA, WHERE THE MATRIX IS STORED IN PACKED FORM.

SSPFA FACTORS A REAL SYMMETRIC MATRIX STORED IN PACKED FORM BY ELIMINATION WITH SYMMETRIC PIVOTING.

SSISL SOLVES THE REAL SYMMETRIC SYSTEM  $A * X = B$  USING THE FACTORS COMPUTED BY SSPFA.

SSVDC REDUCES A REAL  $N \times P$  MATRIX  $X$  BY ORTHOGONAL TRANSFORMATIONS  $U$  AND  $V$  TO DIAGONAL FORM.

STRCO ESTIMATES THE CONDITION OF A REAL TRIANGULAR MATRIX.

STRDI COMPUTES THE DETERMINANT AND INVERSE OF A REAL TRIANGULAR MATRIX.

STRSL SOLVES SYSTEMS OF THE FORM  $T * X = B$  OR  $TRANS(T) * X = B$  WHERE  $T$  IS A TRIANGULAR MATRIX OF ORDER  $N$ .

## MINPACK

MINPACK IS A PACKAGE OF 23 FORTRAN SUBPROGRAMS (11 ARE USER-CALLABLE) TO SOLVE NON-LINEAR EQUATIONS AND NON-LINEAR LEAST SQUARES PROBLEMS. IT WAS OBTAINED FROM ARGONNE NATIONAL LABORATORY.

REFERENCES: ANL-80-74

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCTAPE' (SEE PAGE 1-2).

USER-CALLABLE ROUTINES IN LIBRARY 'MINPACK' INCLUDE:

CHKDER	CHECK THE GRADIENTS OF M NONLINEAR FUNCTIONS IN N VARIABLES, EVALUATED AT A POINT X, FOR CONSISTENCY WITH THE FUNCTIONS THEMSELVES
HYBRD	FIND A ZERO OF A SYSTEM OF N NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE POWELL HYBRID METHOD
HYBRD1	FIND A ZERO OF A SYSTEM OF N NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE POWELL HYBRID METHOD
HYBRJ	FIND A ZERO OF A SYSTEM OF N NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE POWELL HYBRID METHOD
HYBRJ1	FIND A ZERO OF A SYSTEM OF N NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE POWELL HYBRID METHOD
LMDER	MINIMIZE THE SUM OF THE SQUARES OF M NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE LEVELBERG-MARQUARDT ALGORITHM
LMDER1	MINIMIZE THE SUM OF THE SQUARES OF M NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE LEVELBERG-MARQUARDT ALGORITHM
LMSTR	MINIMIZE THE SUM OF THE SQUARES OF M NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE LEVELBERG-MARQUARDT WHICH USES MINIMAL STORAGE
LMSTR1	MINIMIZE THE SUM OF THE SQUARES OF M NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE LEVELBERG-MARQUARDT ALGORITHM WHICH USES MINIMAL STORAGE
LMCIF	MINIMIZE THE SUM OF THE SQUARES OF M NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE LEVELBERG-MARQUARDT ALGORITHM
LMCIF1	MINIMIZE THE SUM OF THE SQUARES OF M NON-LINEAR FUNCTIONS IN N VARIABLES BY A MODIFICATION OF THE LEVELBERG-MARQUARDT ALGORITHM

## MSL (PROPRIETARY)

THE CDC MATH SCIENCE LIBRARY CONTAINS OVER 300 NUMERICAL MATHEMATICAL ROUTINES COVERING THE FOLLOWING EIGHT AREAS:

- .PROGRAMMED ARITHMETIC
- .ELEMENTARY FUNCTIONS
- .POLYNOMIALS AND SPECIAL FUNCTIONS
- .ORDINARY DIFFERENTIAL EQUATIONS
- .INTERPOLATION, APPROXIMATION AND QUADRATURE
- .LINEAR ALGEBRA
- .PROBABILITY, STATISTICS AND TIME SERIES
- .NONLINEAR EQUATION SOLVERS

REFERENCE: MATH SCIENCE LIBRARY, VOLUMES 1-8, CDC PUBLICATION NUMBER 60327500.

## ROUTINES IN LIBRARY 'MSL' INCLUDE:

- ACFI SINGLE CONTINUED FRACTION INTERPOLATION ON TABULAR DATA WITH ARBITRARY SPACING
- ADR ADD COEFFICIENTS OF LIKE POWERS OF TWO REAL POLYNOMIALS
- AITKEN AITKEN'S INTERPOLATION OF ORDER N-1 (ORDER RANGE FROM 1-9)
- AMCON PROVIDE CERTAIN MACHINE AND MATHEMATICAL CONSTANTS AS SINGLE PRECISION NUMBERS OF MAXIMUM ACCURACY
- ATSM SELECT A SUBTABLE ORDERED, ACCORDING TO PROXIMITY, OF THOSE POINTS THAT HAVE ABSCISSAE CLOSEST TO A GIVEN VALUE, FROM A MONOTONE ORDERED TABLE
- BALANC BALANCE A COMPLEX MATRIX BY THE USE OF DIAGONAL SIMILARITY TRANSFORMATIONS
- BANEIG DETERMINE A SPECIFIED NUMBER OF THE SMALLEST EIGENVALUES AND ASSOCIATED EIGENVECTORS OF THE ALGEBRAIC EIGENVALUE PROBLEM  $A*VI=LAMBDA*B*VI$  WHERE A IS A SYMMETRIC, NONNEGATIVE DEFINITE, NARROW BAND MATRIX AND B IS A POSITIVE DEFINITE DIAGONAL MATRIX
- BCHSDC DECOMPOSE A REAL, SYMMETRIC POSITIVE BAND MATRIX INTO (BANDED) UPPER AND LOWER TRIANGULAR FACTORS
- BDCWNP DECOMPOSE A BANDED MATRIX INTO BANDED LOWER AND UPPER TRIANGULAR FACTORS WITH NO PIVOTING
- BDECOM DECOMPOSE A BANDED MATRIX B INTO BANDED LOWER AND UPPER TRIANGULAR FACTORS L AND U, WITH IMPLICIT EQUILIBRATION AND PARTIAL PIVOTING
- BESNIS EVALUATE A TABLE FOR THE BESSEL FUNCTION  $I(x)$  FOR  $N=0,1,2,3,\dots,J-1$
- BESNKS EVALUATE A TABLE OF VALUES OF THE BESSEL FUNCTION  $K(x)$

BETAR COMPUTE INCOMPLETE BETA RATIO (OF THE INCOMPLETE BETA FUNCTION AT X,P,Q TO THE COMPLETE BETA FUNCTION AT P,Q)

BFBANP SOLVE  $LY=B$  AND  $UX=Y$  BY BACK SUBSTITUTIONS - WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND, L AND U ARE LOWER AND UPPER TRIANGULAR FACTORS, POSSIBLY OBTAINED FROM BDCWNP

BFBSUM SOLVE  $LY=B$  AND  $UX=Y$  BY BACK SUBSTITUTIONS - WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND, L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM BDECOM

BITERM SOLVE A SYSTEM OF LINEAR EQUATIONS WITH ITERATIVE REFINEMENT FOR SYSTEMS HAVING A BAND COEFFICIENT MATRIX

BITRFM SOLVE, WITH ITERATIVE REFINEMENT, A SYSTEM OF LINEAR EQUATIONS HAVING A BAND COEFFICIENT MATRIX

BITRNP SOLVE, WITH ITERATIVE REFINEMENT, A SYSTEM OF LINEAR EQUATIONS HAVING A BAND COEFFICIENT MATRIX

BITRPD SOLVE A SYSTEM OF LINEAR EQUATIONS WITH ITERATIVE REFINEMENT, GIVEN THE TRIANGULAR DECOMPOSITION

BITWNP SOLVE, WITH ITERATIVE REFINEMENT, A SYSTEM OF LINEAR EQUATIONS HAVING A BAND COEFFICIENT MATRIX

BLCKDQ SOLVE A SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS AT A POINT B, GIVEN THE (INITIAL) VALUES AT A POINT A

BLESOM SOLVE A SYSTEM OF N LINEAR EQUATIONS (WITH M RIGHT-HAND SIDES), HAVING A BAND COEFFICIENT MATRIX

BLSWNP SOLVE A SYSTEM OF LINEAR EQUATIONS (WITH SEVERAL RIGHT-HAND SIDES), HAVING A BAND COEFFICIENT MATRIX, USING NO PIVOTING

BPDITM SOLVE A SYSTEM OF LINEAR EQUATIONS WITH ITERATIVE REFINEMENT - A BANDED, SYMMETRIC SYSTEM WITH POSITIVE DEFINITENESS

BPDSFB SOLVE  $LY=B$  AND  $LTX=Y$  BY BACK SUBSTITUTIONS - WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND L AND LT ARE THE LOWER TRIANGULAR FACTOR AND ITS TRANSPOSE POSSIBLY OBTAINED FROM BCHSDC

BPDSOM SOLVE A POSITIVE DEFINITE SYMMETRIC BAND SYSTEM OF EQUATIONS HAVING M RIGHT-HAND SIDES

BRTLTT COMPUTE THE TEST STATISTIC FOR BARTLETT'S TEST OF HOMOGENEITY OF A GROUP OF VARIANCE ESTIMATES AND DETERMINE THE PROBABILITY OF OBTAINING A VALUE FOR THE TEST STATISTIC LESS THAN THAT OBSERVED

BSU EVALUATE THE SPHERICAL BESSEL FUNCTION  $J(X)$  FOR  $N=-1,0,\dots,I$

BSUBHT FIND A LEAST SQUARES SOLUTION TO AN OVERDETERMINED SYSTEM THAT HAS BEEN DECOMPOSED USING HOUSEHOLDER TRANSFORMATIONS



BVP SOLVE NONLINEAR P-POINT BOUNDARY VALUE PROBLEM IN ORDINARY DIFFERENTIAL EQUATIONS

CADR ADD COEFFICIENTS OF LIKE POWERS OF TWO COMPLEX POLYNOMIALS

CBAREX EVALUATE  $C**R$  FOR C A COMPLEX NUMBER AND R A REAL NUMBER

CCOMPE EVALUATE A POLYNOMIAL HAVING COMPLEX COEFFICIENTS AT A COMPLEX POINT

CCONGR SOLVE THE RECTANGULAR SYSTEM  $AX\text{-}BAR=B\text{-}BAR$  IN THE LEAST SQUARES SENSE, IF NO EXACT SOLUTION EXISTS - A, B-BAR, X-BAR ARE COMPLEX

CDECOM DECOMPOSE A COMPLEX SQUARE MATRIX INTO POWER AND UPPER TRIANGULAR MATRICES WITH PARTIAL PIVOTING AND ROW EQUILIBRATION

CDERIV GIVEN THE COMPLEX COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE COMPLEX COEFFICIENTS OF THE DERIVATIVE POLYNOMIAL

CEL3 COMPUTE THE COMPLETE ELLIPTIC INTEGRAL OF THE THIRD KIND

CFBSUM SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS WITH COMPLEX ELEMENTS, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM CDECOM

CFQME CONSTRUCT THE MINIMAX POLYNOMIAL THROUGH A DISCRETE, WEIGHTED, SET OF POINTS

CGITRF SOLVE A COMPLEX SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDE COMPLEX COLUMN VECTORS WITH ITERATIVE REFINEMENT

CGLESM SOLVE A COMPLEX SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDES

CHEBAP FIND A CLOSE APPROXIMATION TO A MINIMAX FIT OF A GIVEN FUNCTION OVER A GIVEN INTERVAL

CHEBEV EVALUATE A CHEBYCHEV POLYNOMIAL AT A GIVEN POINT

CHIDST PERFORM THE CHI-SQUARE DISTRIBUTION TEST

CHIPRB COMPUTE THE PROBABILITY OF OBTAINING A VALUE OF CHI-SQUARE WHICH IS LESS THAN OR EQUAL TO THE GIVEN VALUE CHI-SQUARE

CHIRAB PERFORM A CHI-SQUARE TEST FOR RUNS ABOVE AND BELOW ZERO - TESTS HYPOTHESIS THAT A SAMPLE OF RANDOM VARIABLES IS OBTAINED FROM A POPULATION WHICH IS SYMMETRICALLY DISTRIBUTED ABOUT ZERO

CHIRUD PERFORM THE CHI-SQUARE TEST FOR RUNS UP AND DOWN

CHSDEC DECOMPOSE A POSITIVE DEFINITE SYMMETRIC MATRIX INTO A LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE

CHSQO      FUNCTION TO COMPUTE THE VALUE OF CHI-SQUARE WHEN GIVEN THE EXPECTED AND OBSERVED FREQUENCIES

CHTOL      EVALUATE THE DISTANCE OF A POINT TO A LINE

CINPRD      COMPUTE THE INNER PRODUCT OF TWO VECTORS HAVING COMPLEX COEFFICIENTS IN DOUBLE PRECISION

CINT      GIVEN THE COMPLEX COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE COEFFICIENTS OF THE INTEGRAL POLYNOMIAL

CITERF      SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS WITH ITERATIVE REFINEMENT, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS HAVING COMPLEX ELEMENTS, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM CDECOM - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

CLDIV      DIVIDE A POLYNOMIAL WITH COMPLEX COEFFICIENTS BY THE LINEAR EXPRESSION  $(X+B)$  WHERE B IS COMPLEX

CMPYR      FIND THE PRODUCT OF TWO POLYNOMIALS WHEN ANY OF THE COEFFICIENTS ARE COMPLEX

CNSLVL      ESTIMATE THE ERROR PERFORMED IN THE EVALUATION OF A COMPLEX POLYNOMIAL IN THE NEIGHBORHOOD OF ONE OF ITS ROOTS

COMBES      COMPUTE A TABLE OF BESSEL FUNCTIONS OF THE FIRST AND SECOND KINDS FOR COMPLEX ARGUMENT AND ORDERS

COMCUB      FIND THE SLOPES AT A GIVEN SET OF POINTS OF THE CUBIC SPLINE PASSING THROUGH THE POINTS

COMPEV      EVALUATE A REAL POLYNOMIAL AT A COMPLEX POINT

CONRAY      PERFORM ARITHMETIC OPERATIONS ON THE OBSERVATIONS OF ONE VARIABLE IN A MULTIPLEXED DATA ARRAY AND A SPECIFIED CONSTANT

CORCOV      COMPUTE EITHER THE AUTOCORRELATION COEFFICIENTS OR THE AUTOVARIANCE COEFFICIENTS FOR ONE OF THE VARIABLES IN A MULTIPLEXED DATA ARRAY

COSEVL      EVALUATE A COSINE POLYNOMIAL AT A GIVEN POINT

CPDIV      PROVIDE THE QUOTIENT AND REMAINDER OBTAINED BY DIVIDING ONE POLYNOMIAL BY ANOTHER - COEFFICIENTS MAY BE COMPLEX

CPOLRT      FIND ALL ROOTS OF AN NTH DEGREE POLYNOMIAL HAVING COMPLEX COEFFICIENTS

CPTRAN      COORDINATE TRANSLATION SUCH THAT THE POLYNOMIAL  $P(X)$  BECOMES  $P(X+T) - P(X)$  MAY HAVE COMPLEX COEFFICIENTS.

CQDIV     DIVIDE THE COMPLEX POLYNOMIAL BY THE QUADRATIC EXPRESSION  
           $(X^2+BX+C)$ , B AND C COMPLEX

CREV     REVERSE THE ORDER OF POLYNOMIAL COEFFICIENTS IN AN ARRAY -  
          COEFFICIENTS MAY BE COMPLEX

CSBR     SUBTRACT COEFFICIENTS OF LIKE POWERS OF TWO POLYNOMIALS -  
          COEFFICIENTS MAY BE COMPLEX

CSHRNK   COMPUTE THE COEFFICIENTS OF THE POLYNOMIAL  $P(AX)$  FROM THE  
          COEFFICIENTS OF THE POLYNOMIAL  $P(X)$  - COMPLEX COEFFICIENTS

CUBIC2   FIT A CUBIC TO TWO POINTS, GIVEN THE SLOPE AT EACH

CURV     EVALUATE THE MERIT FUNCTION FOR A GIVEN DATA SET

DCBHT    REDUCE A GIVEN MATRIX TO UPPER TRIANGULAR FORM BY HOUSEHOLDER  
          TRANSFORMATIONS

DCWNE    DECOMPOSE A SQUARE MATRIX INTO LOWER AND UPPER TRIANGULAR  
          MATRICES WITH PARTIAL PIVOTING BUT WITHOUT ROW EQUILIBRATION

DCWNP    DECOMPOSE A SQUARE MATRIX INTO LOWER AND UPPER TRIANGULAR  
          MATRICES WITHOUT PIVOTING

DECOM    DECOMPOSE A SQUARE MATRIX INTO LOWER AND UPPER TRIANGULAR  
          MATRICES WITH PARTIAL PIVOTING AND ROW EQUILIBRATION

DEIG     SOLVE FOR THE EIGENVALUES AND RIGHT EIGENVECTORS OF THE  
          DYNAMICAL SYSTEM  $AX+BX+CX=0$  WHERE A, B, C ARE REAL, BUT  
          OTHERWISE GENERAL, MATRICES

DERIV    GIVEN THE REAL COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE REAL  
          COEFFICIENTS OF THE DERIVATIVE POLYNOMIAL

DETERM   CALCULATE THE DETERMINANT OF A SQUARE MATRIX IN THE FORM  
           $D1*(2**D2)$  USING THE INFORMATION FROM THE SUBROUTINE DECOM

DIFTAB   DIFFERENTIATE NUMERICALLY A FUNCTION GIVEN AS A TABLE WITH  
          EQUISPACED ARGUMENTS

DLETE    REMOVE SPECIFIED OBSERVATIONS FROM A DATA ARRAY

DRATEX   SOLVE NUMERICALLY INITIAL VALUE PROBLEMS IN ORDINARY  
          DIFFERENTIAL EQUATIONS

DSCRPT   COMPUTE MEANS, STANDARD DEVIATIONS, VARIANCES, AND  
          COEFFICIENTS OF SKEWNESS AND KURTOSIS FOR MULTIPLEXED DATA  
          ARRAYS

DSCRP2   DETERMINE THE MEDIAN, MINIMUM, MAXIMUM AND RANGE FOR EITHER A  
          SINGLE VARIABLE IN A MULTIPLEXED DATA ARRAY OR ALL THE  
          VARIABLES IN A MULTIPLEXED DATA ARRAY

DTSHT    FURNISH A GUESS OF AN EIGENVALUE TO A COMPLEX HESSENBERG  
          MATRIX

EIGCHK GIVEN AN APPROXIMATE EIGENVALUE/EIGENVECTOR PAIR OF A REAL SYMMETRIC MATRIX A, AND THE MATRIX, AND ESTIMATES OF THE CLOSEST EIGENVALUES TO THE GIVEN EIGENVALUE, PROVIDE ERROR BOUNDS AND POSSIBLY REFINEMENT OF THE EIGENVALUE

EIGCO1 GIVEN AN APPROXIMATION TO AN EIGENVALUE OF A REAL MATRIX HAVING REAL AND DISTINCT ROOTS, CONVERGE TO THE EIGENVALUE-EIGENVECTOR PAIR WHOSE EIGENVALUE IS NEAREST TO THIS APPROXIMATION

EIGIMP REFINE THE EIGENVECTORS OBTAINED FROM SUBROUTINE EIGVCH (WIELANOT INVERSE ITERATION)

EIGSYM FIND ALL EIGENVECTORS OF A REAL, SYMMETRIC MATRIX - SUBSET OF EIGENVECTORS MAY ALSO BE FOUND

EIGVCH COMPUTE THE EIGENVECTORS CORRESPONDING TO A REAL EIGENVALUE OF A REAL UPPER HESSENBERG MATRIX

EIG5 FIND ALL, OR OPTIONALLY A SUBSET OF THE EIGENVALUES OF A GENERAL, REAL-ELEMENTED MATRIX

ELF EVALUATE THE INCOMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND

ELK EVALUATE THE COMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND

EL3 COMPUTE THE ELLIPTIC INTEGRAL OF THE THIRD KIND

ERF COMPUTE THE ERROR FUNCTION

ERFINV FIND THE INVERSE ERROR FUNCTION - COMPUTE THE UPPER LIMIT OF THE INTEGRAL IN THE ERROR FUNCTION

EVREAL EVALUATE A POLYNOMIAL HAVING REAL COEFFICIENTS AT A REAL VALUE OF THE INDEPENDENT VARIABLE

EXRAND GENERATE RANDOM NUMBERS HAVING A NEGATIVE EXPONENTIAL DISTRIBUTION

FABSV COMPUTE THE VALUE OF THE MODULUS OF A VECTOR

F2FRAC ADD TWO FRACTIONS AND EXPRESS THE RESULT AS A FRACTION IN ITS LOWEST FORM

F2FBM SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS, AND U AND L ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOMPOSITION OF A. ALSO SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS, WHERE B IS A COLUMN VECTOR, AND U AND L ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOMPOSITION OF A.

THE RECTANGULAR EQUATION SYSTEM  $AX-\bar{B}=B-\bar{B}$  IN THE LEAST SQUARES SENSE. IF NO EXACT SOLUTION EXISTS - A, X-BAR, B-BAR, B-BAR.

FCLSQ     CONSTRUCT A LEAST SQUARE POLYNOMIAL OF A SPECIFIED DEGREE  
          WHOSE GRAPH APPROXIMATES A SET OF DATA POINTS

FDLSQ     CONSTRUCT A LEAST SQUARE POLYNOMIAL APPROXIMATION OF SOME  
          PRE-ASSIGNED DEGREE TO A SET OF DATA POINTS WITH GIVEN WEIGHT  
          WHERE THE POLYNOMIAL IS CONSTRAINED AT N POINTS AND THE  
          DERIVATIVE IS ALSO CONSTRAINED AT THE FIRST M OF THE N POINTS  
          WHERE  $M \leq N$

FFRAC     CHANGE A VECTOR WITH FRACTIONAL COMPONENTS INTO ONE WITH  
          INTEGER COMPONENTS TIMES A SCALAR FRACTION

FHRNEW     CONSTRUCT THE HERMETIAN POLYNOMIAL OF DEGREE  $N+M+1$  THROUGH  
           $N+1$  COORDINATES WITH DERIVATIVES AT THE FIRST  $M+1$  POINTS

FILTER     COMPUTE THE OUTPUTS FROM A MOVING AVERAGE -- AUTOGRESSIVE  
          FILTER - BOTH INPUT AND OUTPUT ARRAYS MAY BE MULTIPLEXED  
          ARRAYS

FITLIN     FIND THE BEST FIT LINE - MINIMIZE THE SUM OF THE SQUARES OF  
          THE PEPENDICULAR DISTANCES FROM THE POINTS TO THE LINE

FLGNEW     CONSTRUCT THE NTH DEGREE LAGRANGIAN THROUGH  $N+1$  COORDINATES  
           $X(I)$ ,  $AF(I)$

FLSQFY     FIND A LEAST SQUARES POLYNOMIAL OF SPECIFIED DEGREE WHOSE  
          GRAPH APPROXIMATES A SET OF DATA POINTS

FMFRAC     MULTIPLY TWO FRACTIONS AND EXPRESS THE RESULT AS A FRACTION  
          IN ITS LOWEST TERMS

FMMX       MATRIX-MATRIX MULTIPLICATION

FMTMX       MULTIPLY THE TRANSPOSE OF A MATRIX BY A MATRIX ON THE RIGHT

FMTR       TRANSPOSE AN M BY N MATRIX

FMTVCX      MULTIPLY THE TRANSPOSE OF A COMPLEX MATRIX ON THE RIGHT BY A  
          COMPLEX VECTOR

FMTVX       MULTIPLY THE TRANSPOSE OF A MATRIX BY A VECTOR

FMULT1      MULTIPLY A GIVEN NTH DEGREE POLYNOMIAL BY A GIVEN LINEAR  
          FACTOR TO GIVE AN  $(N+1)$ TH DEGREE POLYNOMIAL

FMVCX       MULTIPLY A COMPLEX MATRIX ON THE RIGHT BY A COMPLEX VECTOR

FMVX       MATRIX-VECTOR MULTIPLICATION

FNORM1      NORMALIZE A VECTOR

FOURAP      FIND THE LEAST SQUARES APPROXIMATING TRIGONOMETRIC POLYNOMIAL  
          TO A SET OF GIVEN DATA HAVING EQUISPACED ABSCISSAE

FOURI FIND AN INTERPOLATING TRIGONOMETRIC POLYNOMIAL TO A SET OF DATA HAVING EQUISPACED ABSCISSAE

FPUR SUBTRACT FROM A VECTOR ITS COMPONENT ALONG ANOTHER VECTOR

GAMAIN COMPUTE THE INCOMPLETE GAMMA FUNCTION

GAMMA EVALUATE THE GAMMA FUNCTION OF A REAL ARGUMENT X

GITRFM SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDES WITH ITERATIVE REFINEMENT

GITRFS SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITH ITERATIVE REFINEMENT

GLESON SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING M RIGHT-HAND SIDES

GLESON SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE

GMI EVALUATE NUMERICALLY A SINGLE, DOUBLE OR M-TUPLE (M.LE.10) INTEGRAL OF AN ARBITRARY INTEGRAND BETWEEN ARBITRARY LIMITS

HANKEL EVALUATE THE COMPLEX-VALUED HANKEL FUNCTION OF THE FIRST OR SECOND KIND FOR REAL ARGUMENT AND INTEGER ORDER

HARM COMPUTE A FINITE DISCRETE COMPLEX FOURIER TRANSFORM OF A ONE-, TWO- OR THREE-DIMENSIONAL ARRAY OF COMPLEX FOURIER AMPLITUDES

HCF FIND THE HIGHEST COMMON FACTOR OF TWO INTEGERS

HELP CALCULATE THE ROOTS OF A POLYNOMIAL HAVING COMPLEX COEFFICIENTS

HERMIT EVALUATE THE INTEGRAL OF  $E^{(-X^2)}F(X)$  FROM NEGATIVE TO POSITIVE INFINITY WITH  $F(X)$  A REAL FUNCTION OF ONE VARIABLE

HRMT1 PERFORM INTERPOLATION, GIVEN A VALUE OF THE INDEPENDENT VARIABLE AND A TABLE OF CORRESPONDING VALUES OF THE INDEPENDENT AND DEPENDENT VARIABLE AND ITS DERIVATIVE - EXTRAPOLATION IS ALLOWED

HRMT2 PERFORM HERMITE INTERPOLATIONS, GIVEN AN ARRAY OF VALUES OF THE INDEPENDENT VARIABLE, AND A TABLE OF CORRESPONDING VALUES OF THE INDEPENDENT AND THE DEPENDENT VARIABLE AND ITS DERIVATIVE

HSSN REDUCE A GENERAL REAL MATRIX TO AN UPPER HESSENBERG FORM BY A SIMILARITY TRANSFORMATION AND PROVIDE THE ELEMENTS IF THE TRANSFORMATION MATRIX

HSTGRM DETERMINE THE NUMBER OF OBSERVATIONS OF A RANDOM VARIABLE WHICH LIE IN USER SPECIFIED INTERVALS - USED FOR DISTRIBUTION TESTS AND FOR PLOTTING HISTOGRAMS

INRPRD COMPUTE THE INNER PRODUCT OF TWO VECTORS

INT GIVEN THE REAL COEFFICIENTS OF A POLYNOMIAL, COMPUTE THE COEFFICIENTS OF THE INTEGRAL POLYNOMIAL

INVERS FIND THE INVERSE OF A SQUARE MATRIX USING DECOM AND FBSUBM

INVITR FIND THE INVERSE OF A SQUARE MATRIX WITH ITERATIVE REFINEMENT

IRAND GENERATE RANDOM INTEGERS BETWEEN TWO GIVEN VALUES - EACH OF THE INTEGERS BETWEEN THE GIVEN LIMITS HAS AN EQUAL PROBABILITY OF OCCURRING

ITERFM SOLVE  $LY=B$  AND  $LX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN INTERACTIVE REFINEMENT, WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOM - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITERFS SOLVE  $LY=B$  AND  $LX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN INTERACTIVE REFINEMENT, WHERE B IS A COLUMN VECTOR, AND L AND U ARE LOWER AND UPPER TRIANGULAR MATRICES OBTAINED FROM DECOM - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITERIN PERFORM THE ITERATIVE REFINEMENT FOR THE INVERSE OF A SQUARE MATRIX

ITRLSQ PERFORM THE ITERATIVE REFINEMENT OF A LEAST SQUARES SOLUTION OBTAINED FROM THE SUBROUTINE BSUBHT

ITRPDM SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN ITERATIVE REFINEMENT FOR A POSITIVE DEFINITE SYSTEM  $AX=B$  (B IS A MATRIX CONSISTING OF M COLUMN VECTORS AND L AND U ARE THE LOWER TRIANGLE MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITRPDS SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS WITH AN ITERATIVE REFINEMENT FOR A POSITIVE DEFINITE SYSTEM  $AX=B$  (B IS A COLUMN VECTOR AND L AND U ARE THE LOWER TRIANGLE MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITRSPM SOLVE  $LY=B$  AND  $DLTX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS WITH ITERATIVE REFINEMENT (WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS, AND L AND LT ARE A LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, D IS A DIAGONAL MATRIX, OBTAINED FROM SPDCOM) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

ITRSPS SOLVE  $LY=B$  AND  $DLTX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS WITH ITERATIVE REFINEMENT (WHERE B IS A COLUMN VECTOR, AND L AND LT ARE A LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, D IS A DIAGONAL MATRIX, OBTAINED FROM SPDCOM) - PROVIDE THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX AND THE NUMBER OF CORRECT DIGITS IN THE FIRST COMPUTED SOLUTION

LAGDIF DIFFERENTIATE NUMERICALLY A TABULAR FUNCTION, AT ANY POINT

LAGINT PERFORM LAGRANGIAN INTERPOLATION AT A GIVEN ABSCISSA

LAGRAN EVALUATE THE INTEGRAL OF A REAL FUNCTION OF ONE VARIABLE, GIVEN THE ARRAYS OF THE INDEPENDENT AND THE DEPENDENT VARIABLES

LAGUER EVALUATE THE INTEGRAL OF  $F(X)DX$  FROM A TO  $E^{**}-X$  WITH  $F(X)$  A REAL FUNCTION OF ONE VARIABLE AND  $E^{**}-X$  THE WEIGHTING FN

LATNTR FIND THE EIGENVALUES (REAL AND COMPLEX) OF A REAL MATRIX

LCM FIND THE LEAST COMMON MULTIPLE OF TWO INTEGERS

LDIV DIVIDE A POLYNOMIAL WITH REAL COEFFICIENTS BY THE LINEAR EXPRESSION  $(X+B)$  - B IS REAL

LEGEND EVALUATE THE INTEGRAL OF A REAL FUNCTION OF ONE VARIABLE OVER A FINITE INTERVAL, WHEN THE FUNCTION GENERATOR IS GIVEN

LESWNE SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITH PARTIAL PIVOTING BUT WITHOUT ROW EQUILIBRATION - PROVIDE DATA FOR CALCULATING THE DETERMINANT

LESWNP SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITHOUT PIVOTING

LINBVP SOLVE NUMERICALLY LINEAR P-POINT BOUNDARY POINT PROBLEMS IN N FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

LINSYS SOLVE GENERAL SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS - PROVIDE THE DATA TO EVALUATE READILY THE DETERMINANT OF THE COEFFICIENT MATRIX

LITWNE SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITH ITERATIVE REFINEMENT, WITH PARTIAL PIVOTING, WITHOUT ROW EQUILIBRATION - PROVIDE THE DATA FOR CALCULATING THE DETERMINANT AND THE DATA FOR ESTIMATING THE CONDITION NUMBER OF THE COEFFICIENT MATRIX



LITWNP	SOLVE A GENERAL SYSTEM OF LINEAR EQUATIONS HAVING ONE RIGHT-HAND SIDE WITH ITERATIVE REFINEMENT AND WITHOUT PIVOTING
LOGGAM	COMPUTE THE NATURAL LOGARITHM OF THE GAMMA FUNCTION FOR COMPLEX ARGUMENT
LSQHTM	SOLVE LINEAR LEAST SQUARES PROBLEMS FOR AN OVERDETERMINED SYSTEM WITH K RIGHT-HAND SIDES BY HOUSEHOLDER TRANSFORMATIONS
LSQHTS	SOLVE LINEAR LEAST SQUARES PROBLEMS FOR AN OVERDETERMINED SYSTEM WITH ONE RIGHT-HAND SIDE BY HOUSEHOLDER TRANSFORMATIONS
LSQSIT	SOLVE LINEAR LEAST SQUARES PROBLEMS BY HOUSEHOLDER TRANSFORMATION, USING ITERATIVE REFINEMENT
MIGEN	FIND A MINIMAX FUNCTION APPROXIMATION TO A SET OF POINTS IN TERMS OF A LINEAR COMBINATION OF A PRESCRIBED SET OF FUNCTIONS
MILN2	SMOOTH A SET OF DATA BY AN AVERAGING PROCESS
MINRAT	FIND A MINIMAX RATIONAL FUNCTION APPROXIMATION OF GIVEN DEGREE TO A SET OF POINTS
MPYR	FIND THE PRODUCT OF TWO POLYNOMIALS WHEN THE COEFFICIENTS ARE ALL REAL
MULLP	FIND ALL ZEROS OR A SINGLE ZERO OF A POLYNOMIAL HAVING COMPLEX COEFFICIENTS
NBESJ	COMPUTE BESSEL FUNCTIONS OF FIRST KIND FOR REAL ARGUMENT AND INTEGER ORDERS
NEWT	SOLVE A SYSTEM OF NON-LINEAR EQUATIONS
NONLIQ	SOLVE A SYSTEM OF NON-LINEAR ALGEBRAIC EQUATIONS
NRAND	GENERATE PSEUDO-RANDOM NUMBERS WHICH ARE NORMALLY DISTRIBUTED AND STORE VALUES IN A MULTIPLEXED ARRAY
NRICH	ENRICH A SET OF POINTS BY ADDING POINTS ON AN INTERPOLATING CURVE THROUGH THE GIVEN POINTS
NRKVS	SOLVE A SYSTEM OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AT A POINT B WITH INITIAL VALUES GIVEN AT A POINT A
NRKVSH	SOLVE A SYSTEM OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AT A POINT B WITH INITIAL VALUES GIVEN AT A POINT A
NRML	GENERATE PSEUDO-RANDOM NUMBERS HAVING A NORMAL DISTRIBUTION
NRMNO	GENERATE NORMALLY DISTRIBUTED PSEUDO-RANDOM NUMBERS WITH A CONVENIENT WAY OF HANDLING THE TAIL OF THE DISTRIBUTION - STORE THOSE NUMBERS IN A MULTIPLEXED DATA ARRAY

NRSG SOLVE M BY N SYSTEM OF NON-LINEAR EQUATIONS

NSLVL ESTIMATE THE ERROR PERFORMED IN THE EVALUATION OF A REAL POLYNOMIAL AT A COMPLEX POINT IN THE NEIGHBORHOOD OF ONE OF ITS ROOTS

OP1RAY PERFORM ONE OF NINE POSSIBLE TRANSFORMATIONS ON THE OBSERVATIONS OF A SINGLE VARIABLE IN A MULTIPLEXED DATA ARRAY

OP2RAY PERFORM AN ARITHMETIC OPERATION (+, -, \*, /, \*\*) ON THE CORRESPONDING OBSERVATIONS OF TWO VARIABLES STORED IN MULTIPLEXED DATA ARRAYS

ORTHFT FIT A GIVEN SET OF POINTS WITH A LINEAR COMBINATION OF PRESCRIBED GENERAL FUNCTIONS OF LINEARLY INDEPENDENT VARIABLE(S)

ORTHON GIVEN A SET OF N LINEARLY INDEPENDENT REAL VECTORS OF DIMENSION M, CONSTRUCT A SET WHICH SPANS THE SAME SUBSPACE AND WHOSE VECTORS ARE ORTHONORMAL WITH RESPECT TO A DEFINED INNER PRODUCT

PADE APPROXIMATE FUNCTIONS WHICH HAVE MACLAURIN SERIES EXPANSIONS BY RATIONAL FUNCTIONS USING PADE APPROXIMATIONS

PARBL EVALUATE THE INTEGRAL OF A BOUNDED REAL FUNCTION OF ONE REAL VARIABLE OVER A FINITE INTERVAL

PARFAC RESOLVE A RATIONAL FUNCTION INTO PARTIAL FRACTIONS

PBETA COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A BETA DISTRIBUTION

PBINOM COMPUTE THE CUMULATIVE PROBABILITY FOR THE BINOMIAL DISTRIBUTION

PCHY COMPUTE THE CUMULATIVE PROBABILITY FOR THE CAUCHY DISTRIBUTION

PDITRM SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS  $AX=B$  HAVING M RIGHT-HAND SIDES

PDITRS SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS  $AX=B$  HAVING ONE RIGHT-HAND SIDE

PDIV PROVIDE THE QUOTIENT AND REMAINDER OBTAINED BY DIVIDING ONE POLYNOMIAL BY ANOTHER - COEFFICIENTS ARE REAL

PDLSON SOLVE A POSITIVE DEFINITE SYSTEM  $AX=B$  HAVING M RIGHT-HAND SIDES USING THE CHOLESKY DECOMPOSITION

PDLSON SOLVE A POSITIVE DEFINITE SYSTEM  $AX=B$  HAVING ONE RIGHT-HAND SIDE USING THE CHOLESKY DECOMPOSITION

PDSFBM SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM  $AX=B$  - B IS A MATRIX OF M COLUMN VECTORS AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC

PDSFBS SOLVE  $LY=B$  AND  $UX=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM  $AX=B$  - B IS A COLUMN VECTOR AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE OBTAINED FROM CHSDEC

PFDIST COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM AN F- (VARIANCE-RATIO) DISTRIBUTION

PGEOM COMPUTE THE CUMULATIVE PROBABILITY FOR THE GEOMETRIC DISTRIBUTION

PGMMA COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A GAMMA DISTRIBUTION

PHYPGE COMPUTE THE CUMULATIVE PROBABILITY FOR THE HYPERGEOMETRIC DISTRIBUTION

PIBETA DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A BETA DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIBIN DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A BINOMIAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PICHI DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A CHI-SQUARE DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PICHY DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A CAUCHY DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIEXP DETERMINE THE VALUE OF AN EXPONENTIALLY DISTRIBUTED RANDOM VARIABLE WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIFDIS DETERMINE THE VALUE OF A RANDOM VARIABLE FROM AN F DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIGAMA DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A GAMMA DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIGEO DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A GEOMETRIC DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIHYPG DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A HYPERGEOMETRIC DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PILGNM DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A LOG-NORMAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PINBIN DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A NEGATIVE BINOMIAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PINORM DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A NORMAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIPOIS DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A POISSON DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIRAYL DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A RAYLEIGH DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIT DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A STUDENT'S T DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PITRNM DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A TRUNCATED NORMAL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIUNF DETERMINE THE VALUE OF A UNIFORMLY DISTRIBUTED, RANDOM VARIABLE WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIUNFD DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A UNIFORM DISCRETE DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PIWEBL DETERMINE THE VALUE OF A RANDOM VARIABLE FROM A WEIBULL DISTRIBUTION WHEN THE CUMULATIVE PROBABILITY IS GIVEN

PLAGR FORMS AND READS, AT A GIVEN STATION X, THE POLYNOMIAL PASSING THROUGH ALL OF A GIVEN SET OF POINTS

PLGNRM COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING A VALUE LESS THAN OR EQUAL TO X FROM A LOG-NORMAL DISTRIBUTION

PNBIN COMPUTE THE CUMULATIVE PROBABILITY FOR THE NEGATIVE BINOMIAL DISTRIBUTION

PNORM COMPUTE THE CUMULATIVE PROBABILITY FOR A NORMAL DISTRIBUTION

POIS COMPUTE THE CUMULATIVE PROBABILITY FOR THE POISSON DISTRIBUTION

PORAND GENERATE RANDOM INTEGERS HAVING THE POISSON DISTRIBUTION

PRAYL COMPUTE THE CUMULATIVE PROBABILITY FOR THE RAYLEIGH DISTRIBUTION

PRBEXP DETERMINE THE PROBABILITY OF OBTAINING A VARIABLE HAVING VALUE =  $x_0$  FROM A POPULATION HAVING AN EXPONENTIAL DISTRIBUTION

PRBUNF DETERMINE THE PROBABILITY OF OBTAINING A VARIABLE HAVING VALUE =  $x_0$  FROM A POPULATION HAVING A UNIFORM DISTRIBUTION

PRDSUM COMPUTE THE INNER PRODUCT OF TWO VECTORS AND ADD IT TO AN INCOMING VALUE C

PRICH ENRICH A GIVEN ARRAY WHICH DEFINES A CURVE BY INSERTING POINTS SO AS TO OPTIMIZE THE MERIT FUNCTION DEFINED IN CURV

PRONY      CONSTRUCT AN APPROXIMATION WHICH IS THE SUM OF A PRESCRIBED  
NUMBER OF EXPONENTIALS TO A SET OF N DATA POINTS

PROOT      FIND ALL REAL AND COMPLEX ROOTS OF A POLYNOMIAL WITH REAL  
COEFFICIENTS BY THE METHOD OF BAIRSTOW-NEWTON

PTDIST     COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING  
A VALUE LESS THAN OR EQUAL TO X FROM A T- (STUDENT'S)  
DISTRIBUTION

PTRAN      COORDINATE TRANSLATION SUCH THAT POLYNOMIAL  $P(X)$  BECOMES  
 $P(X+T) - P(X)$  HAS REAL COEFFICIENTS

PTRNRM     COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING  
A VALUE LESS THAN OR EQUAL TO X FROM A TRUNCATED NORMAL  
DISTRIBUTION IN THE RANGE BETWEEN A AND B

PUNFD      COMPUTE THE CUMULATIVE PROBABILITY FOR THE DISCRETE UNIFORM  
DISTRIBUTION

PWEBL      COMPUTE THE PROBABILITY OF OBTAINING A RANDOM VARIABLE HAVING  
A VALUE LESS THAN OR EQUAL TO X FROM A WEIBULL DISTRIBUTION

QDIV       DIVIDE A REAL POLYNOMIAL BY THE QUADRATIC EXPRESSION  
( $X^2+BX+C$ ), B AND C REAL

QNWT       SOLVE SYSTEMS OF NON-LINEAR ALGEBRAIC OF TRANSCENDENTAL  
EQUATIONS

QREIGN     FIND ALL EIGENVALUES OF A COMPLEX MATRIX

QR1        PERFORM A SINGLE, COMPLEX QR-ITERATION ON A MATRIX IN UPPER  
HESSENBERG FORM, HAVING REAL SUBDIAGONAL ELEMENTS

QUAD       PERFORM NUMERICAL QUADRATURE ON BOTH WELL-BEHAVED AND  
POORLY-BEHAVED FUNCTIONS

RAND        GENERATE UNIFORMLY DISTRIBUTED OR NORMALLY DISTRIBUTED RANDOM  
NUMBERS

RATL        COMPUTE THE COEFFICIENTS OF THE LEAST SQUARES APPROXIMATION  
TO A SET OF DISCRETE DATA BY A RATIONAL FUNCTION

RAYLGH     COMPUTE THE RAYLEIGH QUOTIENT FOR REAL SYMMETRIC MATRICES

RBESY      COMPUTE BESSEL FUNCTION OF SECOND KIND FOR POSITIVE REAL  
ARGUMENT AND INTEGER ORDERS

RECOV1     RECOVER EIGENVECTORS AFTER A REDUCTION USING A TRIANGULAR  
MATRIX IN THE SIMILARITY TRANSFORMATION

RECOV2     RECOVER EIGENVECTORS OF THE EIGENPROBLEMS  $AY=LAMBDA Y$  OR  
 $YTAB=LAMBDA Y^T$ , WHERE A, B ARE REAL, SYMMETRIC AND B IS  
POSITIVE DEFINITE

REDSY1 REDUCE THE EIGENPROBLEM  $(A - \lambda B)X = 0$  TO A STANDARD SYMMETRIC PROBLEM  $(P - \lambda D)Z = 0$  - A MUST BE REAL SYMMETRIC, B MUST BE REAL SYMMETRIC POSITIVE DEFINITE TO ALLOW THE DECOMPOSITION  $B = LL^T$

REDSY2 REDUCE TO STANDARD FORM THE EIGENPROBLEMS  $(AB - \lambda D)X = 0$  OR  $(BA - \lambda D)Y = 0$ , WHERE A, B ARE REAL SYMMETRIC AND B IS POSITIVE DEFINITE

REV REVERSE THE ORDER OF REAL POLYNOMIAL COEFFICIENTS IN AN ARRAY

RICH ENRICH A GIVEN CURVE DEFINED BY AN ARRAY OF POINTS SO AS TO SATISFY A SPECIFIED CHORD HEIGHT TOLERANCE

RKINIT SOLVE A SYSTEM OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS AT A POINT B WITH INITIAL VALUES GIVEN AS A POINT A

ROMBG EVALUATE THE INTEGRAL OF A REAL FUNCTION OF ONE REAL VARIABLE OVER A FINITE INTERVAL USING ROMBERG INTEGRATION

RQNWTF USES QNWT TO SOLVE SYSTEMS OF NONLINEAR, ALGEBRAIC OR TRANSCENDENTAL EQUATIONS (IT APPEARS TO BE USEFUL IN THAT IT DOES NOT GIVE UP ON DIFFICULT PROBLEMS AS EASILY AS OTHER MSL SUBROUTINES - QNWT SOLVED 34 OF 40 TEST CASES, RQNWTF SOLVED ALL 40)

RUNSAB COUNT THE NUMBER OF RUNS ABOVE AND BELOW ZERO OF DIFFERENT LENGTHS AND THE EXPECTED NUMBER OF RUNS FOR A SAMPLE WHICH IS RANDOMLY SELECTED FROM A POPULATION SYMMETRICALLY DISTRIBUTED ABOUT ZERO

RUNSUD COUNT THE RUNS UP AND DOWN OF DIFFERENT LENGTHS IN A SAMPLE AND DETERMINE THE EXPECTED NUMBER OF RUNS OF DIFFERENT LENGTHS FOR A RANDOM SAMPLE

SBR SUBTRACT COEFFICIENTS OF LIKE POWERS OF TWO REAL POLYNOMIALS

SCONG SOLVE THE EQUATION SYSTEM  $AX = B$  BY THE CONJUGATE GRADIENT METHOD - DESIGNED TO BE USED WHEN THE MATRIX A IS LARGE BUT HAS MANY ZERO ELEMENTS

SEARCH USED IN THE TBLU PACKAGE TO PERFORM A BINARY TABLE SEARCH

SEPAR FIND ALL EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX

SEPAR2 FIND A SUBSET OF EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX

SHRINK COMPUTE THE COEFFICIENTS OF THE POLYNOMIAL  $P(\lambda X)$  FROM THE COEFFICIENTS OF THE POLYNOMIAL  $P(X)$  - REAL COEFFICIENTS

SICI EVALUATE THE SINE AND COSINE INTEGRALS

SIGSMT PERFORM SMOOTHING OF A TRIGONOMETRIC SERIES BY USE OF LANCZOS SIGMA-FACTORS

SIMP        TRANSFORM EIGENVECTORS OF AN UPPER HESSENBERG MATRIX H, WHERE  $H=(P^{*-1})AP$ , TO EIGENVECTORS OF THE SIMILAR MATRIX A

SIMPRC     EVALUATE THE INTEGRAL OF ANY FUNCTION  $Y=F(X)$  BETWEEN THE LIMITS A AND B USING SIMPSON'S RULE

SINEVL     EVALUATE A SINE POLYNOMIAL AT A GIVEN POINT

SINSER     INTERPOLATE A SET OF N (ABSCISSA,ORDINATE)-PAIRS

SMOCUB     PERFORM SMOOTHING

SMOOTH     COMPUTE A VECTOR OF SMOOTHED FUNCTION VALUES GIVEN VECTORS OF ARGUMENT AND CORRESPONDING FUNCTION VALUES

SMTVX     MULTIPLY THE TRANSPOSE OF A LARGE, SPARSE MATRIX BY A VECTOR

SMVX       MATRIX-VECTOR MULTIPLICATION WHEN THE MATRIX IS LARGE AND SPARSE

SPDCOM     DECOMPOSE A POSITIVE DEFINITE SYMMETRIC MATRIX WITHOUT USING THE SQUARE ROOT ROUTINE

SPDFBM     SOLVE  $LY=B$  AND  $X=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM  $AX=B$  (B IS A MATRIX OF M COLUMN VECTORS, AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, AND D THE DIAGONAL MATRIX OBTAINED FROM SPDCOM)

SPDFBS     SOLVE  $LY=B$  AND  $X=Y$  BY FORWARD AND BACKWARD SUBSTITUTIONS FOR A POSITIVE DEFINITE SYSTEM  $AX=B$  (B IS A COLUMN VECTOR, AND L AND U ARE THE LOWER TRIANGULAR MATRIX AND ITS TRANSPOSE, AND D THE DIAGONAL MATRIX OBTAINED FROM SPDCOM)

SPDSOM     SOLVE A POSITIVE DEFINITE SYSTEM  $AX=B$  HAVING M RIGHT-HAND SIDES WITHOUT USING THE SQUARE ROOT ROUTINE

SPDSOS     SOLVE A POSITIVE DEFINITE SYSTEM  $AX=B$  HAVING ONE RIGHT-HAND SIDE WITHOUT USING THE SQUARE ROOT ROUTINE

SPITRM     SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS WITHOUT USING THE SQUARE ROOT ROUTINE WITH ITERATIVE REFINEMENT

SPITRS     SOLVE A POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS WITHOUT USING THE SQUARE ROOT ROUTINE WITH ITERATIVE REFINEMENT

SPLINE     CONSTRUCT A 5TH DEGREE SPLINE INTERPOLATING A SET OF EQUISPACED DATA

START      READ IN AND LIST INPUT DATA WHICH IS TO BE ENRICHED BY USING OTHER MSL ROUTINES

SUBDIA     REDUCE A COMPLEX MATRIX TO UPPER HESSENBERG FORM BY SIMILARITY TRANSFORMATIONS; USING UNITARY MATRICES

SUBDIR     REDUCE A REAL MATRIX TO UPPER HESSENBERG FORM

SUMPS COMPUTE DOUBLE PRECISION SUMS OF THE POWERS OF OBSERVATIONS

SURFS FIT A SMOOTH SURFACE WITH CONTINUOUS FIRST PARTIAL DERIVATIVES TO A SET OF POINTS DEFINED OVER A RECTANGULAR GRID

SYMLR FIND ALL EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX

SYMQR FIND ALL EIGENVALUES OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX

TBLU1 TABLE SEARCH AND INTERPOLATION WITH ONE INDEPENDENT VARIABLE

TBLU2 TABLE SEARCH AND INTERPOLATION WITH TWO INDEPENDENT VARIABLES

TBLU3 TABLE SEARCH AND INTERPOLATION WITH THREE INDEPENDENT VARIABLES

TCDIAG COMPUTE PARTIAL OR COMPLETE EIGENSYSTEMS OF HERMETIAN MATRICES

TERP1 POLYNOMIAL INTERPOLATION FOR ONE INDEPENDENT VARIABLE

TERP2 POLYNOMIAL INTERPOLATION FOR TWO INDEPENDENT VARIABLES

TERP3 POLYNOMIAL INTERPOLATION FOR THREE INDEPENDENT VARIABLES

TRDCNP PERFORM TRIANGULAR DECOMPOSITION OF A TRIDIAGONAL MATRIX WITHOUT PIVOTING

TRDCOM PERFORM TRIANGULAR DECOMPOSITION OF A TRIDIAGONAL MATRIX WITH PARTIAL PIVOTING

TRDFBM PERFORM BACK SUBSTITUTION

TRDSOM SOLVE A TRIDIAGONAL SYSTEM OF EQUATIONS USING TRIANGULAR DECOMPOSITION WITH PARTIAL PIVOTING AND BACK SUBSTITUTION

TRDSUB PERFORM BACK SUBSTITUTION

TRDWNP SOLVE A TRIDIAGONAL SYSTEM OF EQUATIONS USING TRIANGULAR DECOMPOSITION WITHOUT PIVOTING AND BACK SUBSTITUTION

TRGDIF DIFFERENTIATE FORMALLY A TRIGONOMETRIC POLYNOMIAL

TRGINT INTEGRATE FORMALLY A TRIGONOMETRIC POLYNOMIAL

TRIDI REDUCE A REAL, SYMMETRIC MATRIX TO TRIDIAGONAL FORM BY USE OF HOUSEHOLDER'S REDUCTION

TRILOM SOLVE A LOWER TRIANGULAR SYSTEM  $LX=B$  WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS

TRILOS SOLVE A LOWER TRIANGULAR SYSTEM  $LX=B$  WHERE B IS A SINGLE COLUMN VECTOR

TRIUPM SOLVE AN UPPER TRIANGULAR SYSTEM  $UX=B$  WHERE B IS A MATRIX CONSISTING OF M COLUMN VECTORS



TRIUPS SOLVE AN UPPER TRIANGULAR SYSTEM  $UX=B$  WHERE B IS A SINGLE COLUMN VECTOR

TRLOIN INVERT A LOWER TRIANGULAR MATRIX

TRUPIN INVERT AN UPPER TRIANGULAR MATRIX

UNC SPL CONSTRUCT A NONLINEAR CUBIC SPLINE WITH CONTINUOUS SECOND DERIVATIVE THROUGH A GIVEN SET OF DATA

URAND GENERATE UNIFORMLY DISTRIBUTED PSEUDO-RANDOM NUMBERS WITH THE SPECIFIED UPPER AND LOWER LIMITS AND STORE VALUES AS ONE VARIABLE IN A MULTIPLEXED DATA ARRAY

VALVEC FIND ALL (OR A SUBSET OF) EIGENVECTORS OF A COMPLEX MATRIX

VARORD ARRANGE THE OBSERVATIONS OF ONE OF THE VARIABLES IN A MULTIPLEXED DATA ARRAY SO THAT THESE OBSERVATIONS ARE STORED IN INCREASING ORDER

VECORD ORDER A SET OF COMPLEX NUMBERS ACCORDING TO MAGNITUDE, EITHER INCREASING OR DECREASING

VECTOR GIVEN A GOOD APPROXIMATION TO AN EIGENVALUE OF A REAL, SYMMETRIC TRIDIAGONAL MATRIX, FIND THE CORRESPONDING EIGENVECTOR AND TRANSFORM THE RESULT ACCORDING TO STORED INFORMATION ABOUT THE ORIGINAL, FULL MATRIX

VIP COMPUTE THE INNER PRODUCT OF TWO VECTORS

VIPA COMPUTE THE INNER PRODUCT OF TWO VECTORS AND ADD IT TO AN INCOMING VALUE C

VIPD COMPUTE THE INNER PRODUCT OF TWO VECTORS WITH DOUBLE PRECISION ACCUMULATION

VIPDA COMPUTE THE INNER PRODUCT OF TWO VECTORS WITH DOUBLE PRECISION ACCUMULATION AND ADD IT TO AN INCOMING VALUE C

VIPDS COMPUTE THE INNER PRODUCT OF TWO VECTORS WITH DOUBLE PRECISION ACCUMULATION AND SUBTRACT IT FROM AN INCOMING VALUE C

XIRAND GENERATE RANDOM FLOATING POINT NUMBERS BETWEEN TWO GIVEN VALUES - EACH OF THE FLOATING POINT NUMBERS BETWEEN THE GIVEN LIMITS HAS AN EQUAL PROBABILITY OF OCCURRING

XPLOT PRINTER PLOT OF UP TO 5 VARIABLES OR SETS OF DATA (ORDINATE) IN THE ORDER IN WHICH THE VALUES ARE STORED (ABSCISSA)

XYPLOT PRINTER PLOT OF UP TO 5 ORDINATE VARIABLES VERSUS A SINGLE ABSCISSA VARIABLE WHERE THE NUMBER OF VALUES FOR THE ABSCISSA IS THE SAME AS THE NUMBER OF VALUES FOR EACH OF THE ORDINATE VARIABLES

ZAFUJ FIND N ZEROS OF AN ARBITRARY COMPLEX-VALUED FUNCTION OF A COMPLEX VARIABLE

AD-A103 020

DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/6 9/2

COMPUTER CENTER CDC LIBRARIES.(U)

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DTNSRDC/CMLD-81-06

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2 of 2

AD-A103 020



END

DATE

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DTIC

ZAFUM FIND N ZEROS OF AN ARBITRARY COMPLEX-VALUED FUNCTION OF A  
COMPLEX VARIABLE

ZAFUR FIND N ZEROS OF AN ARBITRARY REAL-VALUED FUNCTION OF A REAL  
VARIABLE

ZCOUNT COUNT THE NUMBER OF TIMES A FUNCTION  $F(Z)$  CIRCLES THE ORIGIN  
AS  $Z$  TRANSVERSES ANY CONTOUR MADE UP OF STRAIGHT LINE  
SEGMENTS IN A COMPLEX PLANE, AND HENCE THE NUMBER OF ZEROS OF  
 $F(Z)$  WITHIN CLOSED CONTOURS (IF THERE ARE POLES WITHIN THE  
CONTOUR THEN THE PHRASE "NUMBER OF ZEROS" SHOULD BE REPLACED  
BY "NUMBER OF ZEROS - NUMBER OF POLES")

ZRNM COMPUTE THE MEAN VALUE OF A SET OF OBSERVATIONS AND SUBTRACTS  
THE MEAN FROM EACH OF THE OBSERVATIONS

## NSRDC

'NSRDC' IS A LIBRARY OF DTNSRDC WRITTEN AND/OR SUPPORTED SCIENTIFIC AND UTILITY SUBPROGRAMS.

REFERENCES: MOST OF THESE ROUTINES ARE DOCUMENTED IN CLIB/N, WHICH MAY BE OBTAINED FROM USER SERVICES. OTHER EXISTING DOCUMENTS ARE ON FILE IN USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCGET' (SEE PAGE 1-2).

## ROUTINES IN LIBRARY 'NSRDC' INCLUDE:

AC	GET ACCOUNT NUMBER FOR THIS JOB
ADJL	LEFT ADJUST A LINE OF WORDS LEAVING ONE SPACE BETWEEN WORDS
ADJR	RIGHT ADJUST A LINE OF WORDS LEAVING ONE SPACE BETWEEN WORDS
AI	AIRY FUNCTION INTEGRAL
ALTIME	OBTAIN CPA, CPB, CP, PP, IO AND WALL CLOCK TIMES SINCE START OF JOB (OR INTERCOM SESSION)
AMAXE	FIND MAXIMUM VALUE OF AN ARRAY (ALSO CONTAINS MAXE)
AMINE	FIND MINIMUM VALUE OF AN ARRAY (ALSO CONTAINS MINE)
ANOVA1	ONE-WAY ANALYSIS OF VARIANCE WITH UNEQUAL N
ANOVA2	TWO-WAY ANALYSIS OF VARIANCE WITH EQUAL N
APOWR	EXPONENTIATION OF POWER SERIES - ONE VARIABLE
ARDCFT	PROPERTIES OF U.S. STANDARD ATMOSPHERE (1962)
ASHIFT	SHIFT EACH WORD OF AN ARRAY
ASORT	FTN ALPHANUMERIC SORT
ASORTMV	SORT 2-DIMENSIONAL ARRAY USING A FAST ARRAY MOVING SUBROUTINE
BANR	PRINT A BANNER (LETTERS ARE 10 LINES HIGH, LINES ARE 110 CHARACTERS LONG)
BANR6	PRINT A BANNER (LETTERS ARE 6 LINES HIGH, LINES ARE 80 CHARACTERS LONG)
BEJY0	ZERO-ORDER BESSEL FUNCTIONS FOR REAL ARGUMENTS
BEJY1	FIRST ORDER BESSEL FUNCTIONS FOR REAL ARGUMENTS
BESSI	MODIFIED BESSEL FUNCTION OF THE FIRST KIND

BESSJ	BESSEL FUNCTION OF THE FIRST KIND
BESSK	MODIFIED BESSEL FUNCTION OF THE SECOND KIND
BESSY	BESSEL FUNCTION OF THE SECOND KIND
BMAN	SOLVE SYSTEM $AX=B$ FOR BANDED SYMMETRIC MATRICES
BPOWR	EXPONENTIATION OF POWER SERIES IN TWO VARIABLES
BSJ	SPHERICAL BESSEL FUNCTION
BUFSIZE	PRINT MESSAGE IN DAYFILE FOR EACH FILE SPECIFIED INDICATING BUFFER SIZE AND WHETHER BUFFER IS CURRENTLY ALLOCATED
CBSF	COMPLEX BESSEL FUNCTION FOR LARGE ARGUMENT
CCALL	EXIT PROGRAM AND EXECUTE ONE OR MORE CONTROL CARD
CEI3	COMPLETE ELLIPTIC INTEGRAL OF THE THIRD KIND
CELLI	COMPLETE AND INCOMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND SECOND KIND
CENTER	CENTER A CHARACTER STRING WITHIN AN OUTPUT FIELD
CFILL	FILL AREA WITH ALTERNATING FIELDS OF SPECIFIED CHARACTER AND BLANKS
CGAUSS	COMPLEX SOLUTION OF SIMULTANEOUS EQUATIONS AND DETERMINANT BY ITERATIVE GAUSSIAN ELIMINATION
CHFILL	FILL (PORTION OF) AN ARRAY WITH A CHARACTER
CHNGSEQ	ALLOW COBOL4 USER TO DEFINE A COLLATING SEQUENCE
CLUNLD	CLOSE AND UNLOAD A FILE
CMPINV	COMPLEX MATRIX INVERSION
COMBES	BESSEL FUNCTIONS FOR COMPLEX ARGUMENT AND ORDER
COMPSTR	COMPARE TWO CHARACTER STRINGS
CONTRCT	SQUEEZE ARRAY OF 1R-FORMAT CHARACTERS TO LEFT (SEE EXPAND)
COTAN	COTANGENT FUNCTION
COUPLE	LOGICALLY CONNECT TWO WORDS
CRDTAB	READ TABLES FOR FRMRAN AND FRMRA2 INTERPOLATION
DATCNV	CONVERT DATE FORMATS (USES INTEGERS)
DATFMT	CONVERT DATE FORMATS (USES CHARACTER STRINGS)

DISCOT	SINGLE OR DOUBLE INTERPOLATION
DMPA	CALLABLE OCTAL AND CHARACTER DUMP OF SPECIFIED PORTION OF USER'S FIELD LENGTH (FL) (BY ACTUAL LOCATION) (NO HEADINGS ARE PROVIDED)
DMPCPA	DUMP JOB CONTROL POINT AREA
DPROOT	FIND ALL ROOTS OF A REAL DOUBLE PRECISION POLYNOMIAL
DUMPA	GIVE OCTAL AND CHARACTER DUMP OF USER-SPECIFIED AREA
DUMPCPA	EXPANDED DUMP OF JOB CONTROL POINT AREA
DUMPFL	CALLABLE OCTAL AND CHARACTER DUMP OF SPECIFIED PORTION OF USER'S FIELD LENGTH (FL) (BY ACTUAL LOCATION)
ELLI	ELLIPTIC INTEGRAL
ELLIP	ELLIPTIC INTEGRAL
ELTIME	OBTAIN CPA, CPB, CP, PP, IO AND WALL CLOCK TIMES SINCE LAST CALL TO ELTIME
EQU60	LOGICAL COMPARE OF TWO ARRAYS
ERROR	ERROR FUNCTION
EXPAND	EXPAND CHARACTER STRING INTO ARRAY OF 1R-FORMAT WORDS (SEE CONTRCT)
EXPINT	EXPONENTIAL INTEGRAL
EXPRM	EXTRACT NEXT PARAMETER FROM EXECUTE CARD
EXTBIT	EXTRACT BITS FROM A WORD
EXTPRM	EXTRACT NEXT PARAMETER FROM USER-SUPPLIED PARAMETER STRING
FASTIN	READ AND UNPACK DATA PREPARED ON THE XDS-910 A/D CONVERSION SYSTEM
FBINRD	UNPACK AN INPUT ARRAY (N BITS PER INPUT CHARACTER INTO CDC WORD)
FFT	FAST FOURIER TRANSFORM FOR COMPLEX TABULATED FUNCTION
FFT5	FAST FOURIER TRANSFORM
FGI	FORTTRAN GAUSSIAN INTEGRATION
FINDC	FIND PRESENCE OR ABSENCE OF SPECIFIED CHARACTER IN AN ARRAY (USER SPECIFIES RELATIONAL OPERAND)
FINDW	FIND PRESENCE OR ABSENCE OF SPECIFIED WORD IN AN ARRAY (USER SPECIFIES RELATIONAL OPERAND)

FINDWRD	FIND SPECIFIED WORD IN AN ARRAY
FNOL3	INTEGRATE SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS
FRESNEL	EVALUATE FRESNEL INTEGRALS
FRMRAN	LINEAR TABLE INTERPOLATION (ONE OR TWO INDEPENDENT VARIABLES)
FRMRA2	LINEAR TABLE INTERPOLATION (MULTIPLE INDEPENDENT VARIABLES)
FTNRFL	GET/SET CORE SIZE
GAMCAR	COMPLEX GAMMA FUNCTION OF A COMPLEX ARGUMENT HAVING POSITIVE REAL PART
GAMMA	INCOMPLETE OR COMPLETE GAMMA FUNCTION
GAUSS	SIMULTANEOUS EQUATION SOLUTION WITH DETERMINANT BY ITERATIVE GAUSSIAN ELIMINATION
GETCHA	EXTRACT CHARACTER FROM SPECIFIED POSITION IN AN ARRAY
GETCHR	EXTRACT CHARACTER FROM SPECIFIED POSITION IN A WORD
GETFIT	GET SPECIFIED FIT ADDRESS
GETHOUR	FOR A SPECIFIED PERIOD OF TIME (UP TO 2 HR 59 MIN 59 SEC) DETERMINE WHICH HOUR IS OCCUPIED THE LONGEST
GETLFNS	GET ACTUAL LOCAL FILE NAMES (FOR FTN)
GETLGO	EXTRACT FIRST 10 CHARACTERS OF ALL EXECUTE CARD PARAMETERS
GETLIB	GET SYSTEM LIBRARY NAME FROM CODE IN CONTROL POINT AREA
GETRA	GET PROGRAM COMMUNICATION REGION (RA+0 THRU RA+77B)
GMHAS	HARMONIC ANALYSIS
GODROP	ISSUE USER-SPECIFIED GO/DROP MESSAGE
HELP	COMPLEX ZEROES OF REAL OR COMPLEX POLYNOMIAL
HERF	GET TERMINAL ID FOR THIS JOB
HEX3	SQUEEZE 3-CHARACTER HEX INTO 12 BITS
HIFAC	HIGHEST COMMON FACTOR OF TWO POLYNOMIALS
IAOC	COUNT ONE-BITS IN SPECIFIED WORD
IBL	CALCULATE BEST BLOCK LENGTH (MIN TIME REQ'D FOR RANDOM ACCESS AND MINIMUM BUFFER SIZE) FOR INDEX SEQUENTIAL FILES

IBUNP      UNPACK 12-BIT BYTES FROM ARRAY

ICOM      INTERACTIVE COMMUNICATOR (SYMBOLIC) -- READ RESPONSE AND  
COMPARE WITH LIST OF VALID RESPONSES

ICOMN      INTERACTIVE COMMUNICATOR (INTEGER NUMERIC) -- READ NUMBER  
AND TEST TO SEE IF IN SPECIFIED RANGE

IDAYWEK      FUNCTION TO DETERMINE THE DAY OF THE WEEK FOR ANY DATE FROM  
10/15/1582 THRU 02/28/4000

IDID      GET USER INITIALS (AND INTERCOM USER ID) FROM CHARGE CARD OR  
LOGIN

IDIGIT      CHECK FOR DIGITS IN A FIELD WITHIN A WORD

IFINDCH      FIND FIRST OCCURRENCE OF SPECIFIED CHARACTER IN ARRAY

IFMTV      FAST I-FORMAT DECODE OF VARIABLE LENGTH INPUT

IHMS      CONVERT SECONDS TO ' HH.MM.SS.' (SEE ISEC)

IPAKLFT      SQUEEZE LEFT AND REMOVE ZEROS (00B) AND BLANKS (55B). RETURN  
NUMBER OF CHARACTERS

IRMAN      CONVERT ROMAN NUMBERS TO INTEGER

ISEC      CONVERT HH.MM.SS TO SECONDS (SEE IHMS)

ISITCNF      TEST FOR CONNECTED FILE

ISTAPE      GENERATE TAPE NAME 'TAPENN'

ISUMIT      SUM ELEMENTS OF INTEGER ARRAY

JGDATE      CONVERT ANY GREGORIAN DATE TO A JULIAN DATE AND VICE VERSA  
(MULTI-YEAR)

JOBNAME      GET NOS/BE JOB NAME FOR THIS JOB

JOBORG      GET JOB ORIGIN (BATCH, INTERCOM, GRAPHICS, MULTI-USER)

JULIAN      CONVERT ANY GREGORIAN DATE TO A JULIAN DATE AND VICE VERSA  
(SINGLE YEAR)

KUTMER      INTEGRATE A SYSTEM OF FIRST-ORDER ORDINARY DIFFERENTIAL  
EQUATIONS USING THE KUTTA-MERSON FOURTH-ORDER, SINGLE-STEP  
METHOD

LASTCH      FIND LAST NON-BLANK CHARACTER IN ARRAY



LASTWRD	FIND LAST WORD OF ARRAY WHICH CONTAINS A NON-BLANK
LBYT	EXTRACT VARIABLE LENGTH BYTE
LEFTADJ	SQUEEZE LEFT AND REMOVE BLANKS AND OOB (USER MAY SUPPLY TRAILING FILL CHARACTER)
LINE6	SET PRINT FILE TO 6 LINES PER INCH
LINE8	SET PRINT FILE TO 8 LINES PER INCH
LOGGAM	LOGARITHM OF GAMMA FUNCTION FOR COMPLEX ARGUMENT
LSQSUB	GENERAL WEIGHTED LEAST SQUARES FIT
MAM	SOLVE SYMMETRIC SYSTEM OF LINEAR EQUATIONS
MAM200	SOLVE 200 SYMMETRIC LINEAR EQUATIONS
MASKIT	DYNAMIC MASK GENERATOR
MATINS	MATRIX INVERSE WITH SIMULTANEOUS EQUATION SOLUTION AND DETERMINANT
MAXE	FIND MAXIMUM VALUE OF AN ARRAY (ALSO CONTAINS AMAXE)
MEMUSED	PRINT MESSAGE IN DAYFILE GIVING FIELD LENGTH IN USE AT TIME OF CALL TO THIS ROUTINE
MFETCH	FETCH A SINGLE WORD FROM USER'S FL (SEE MSET)
MFRAME	OBTAIN THE MACHINE AND MAINFRAME RUNNING THE PROGRAM
MINE	FIND MINIMUM VALUE OF AN ARRAY (ALSO CONTAINS AMINE)
MINMAX	GENERALIZED NONLINEAR ITERATOR
MONTH	FROM A DATE (MM/DD/YY) FIND THE MONTH AND RETURN FULL SPELLING AND 3- OR 4-CHARACTER ABBREVIATION
MOVCHAR	MOVE ONE CHARACTER FROM ONE STRING TO ANOTHER
MOVECM	MOVE WORDS FROM ONE AREA IN CORE TO ANOTHER
MOVEIT	MOVE AN ARRAY (MOVLEV REPLACEMENT WHICH CALLS MOVECM)
MOVSTR	MOVE A STRING OF CHARACTERS FROM ONE ARRAY TO ANOTHER
MSET	SET A SINGLE WORD IN USER'S FL (SEE MFETCH)
MXGET	EXTRACT (RIGHT-JUSTIFIED, ZERO-FILLED) 0-10 6-BIT CHARACTERS FROM 60-BIT WORDS
NEWDAT	ADD/SUBTRACT SPECIFIED NUMBER OF DAYS TO/FROM A GIVEN DATE

NFILL      FILL ELEMENTS 1 THRU N OF AN ARRAY WITH THE VALUES 1 THRU N, RESPECTIVELY

NFILLT     TEST AN ARRAY FOR THE PRESENCE OF THE INTEGERS 1 THRU N IN ELEMENTS 1 THRU N, RESPECTIVELY

NROOTS     REAL AND COMPLEX ROOTS OF REAL POLYNOMIAL

NUMEXEC    GET NUMBER OF EXECUTE CARD PARAMETERS WHICH WERE USED IN THIS EXECUTION OF THE PROGRAM

NUMVAR     DETERMINE NUMBER OF ARGUMENTS IN CALL TO SUBPROGRAM

OFMTDE     FAST O-FORMAT DECODE

OFMTV      FAST O-FORMAT DECODE OF VARIABLE LENGTH INPUT

OPLSA      ORTHOGONAL POLYNOMIAL LEAST SQUARE APPROXIMATION

OVLNAME    GET NAME OF FILE CURRENTLY BEING EXECUTED

PARGET     GET ALL PARAMETERS OF USER-SUPPLIED PARAMETER STRING

PFR        SUPPLY DESCRIPTION OF PERMANENT FILE FUNCTION RETURN CODE

PLOTMY     PRINTER PLOT - MULTIPLE CURVES

PLOTPR     PRINTER PLOT - MULTIPLE CURVES

PLOTXY     PRINTER PLOT - SINGLE CURVE

POLDIV     POLYNOMIAL DIVISION

POLYN      LEAST SQUARES POLYNOMIAL FIT

POWR1      1 TERM IN EXPONENTIATION OF POWER SERIES - ONE VARIABLE

POWR2      1 TERM IN EXPONENTIATION OF POWER SERIES - TWO VARIABLES

PROD2      1 TERM IN PRODUCT OF POWER SERIES - TWO VARIABLES

PROOT      FIND ALL ROOTS OF A REAL PLOYNOMIAL

PRTFL      PRINT CURRENT FL (OR PUT INTO DAYFILE)

PRTIME     GET AND PRINT CPA, CPB, CP, PP, IO AND WALL CLOCK TIMES SINCE LAST CALL AND PRINT USER-SUPPLIED MESSAGE

PSI        COMPLEX PSI FUNCTION

PUTCHA     INSERT CHARACTER INTO SPECIFIED POSITION IN AN ARRAY

PUTCHR     INSERT CHARACTER INTO SPECIFIED POSITION IN A WORD

QSORT	IN-CORE ASCENDING SORT FOR REAL ARRAYS LARGER THAN 500 WORDS
QSORT1	IN-CORE ASCENDING SORT WITH RE-ORDERING OF ASSOCIATED ARRAY (FOR REAL ARRAYS LARGER THAN 500 WORDS)
QUADG	INTEGRAL BY GAUSS-LEGENDRE 10-POINT QUADRATURE
QUART	REAL OR COMPLEX ROOTS OF QUARTIC
RANUM	NORMALLY DISTRIBUTED RANDOM NUMBERS
RCPA	READ (A PORTION OF) CONTROL POINT AREA
RECOVRD	ON RECOVERY, PRINT EXCHANGE JUMP PACKAGE, RA+0 THRU RA+77B
REDUCE	REDUCE FL TO MINIMUM -OR- REQUEST ADDITIONAL FL RELATIVE TO START OF BLANK COMMON
REPLAC	REPLACE ONE CHARACTER WITH ANOTHER IN AN ARRAY
REPLACM	REPLACE SEVERAL CHARACTERS WITH OTHER CHARACTERS
REPLHI	REPLACE ALL CHARACTERS GREATER THAN SPECIFIED CHARACTER WITH NEW CHARACTER
REPLLO	REPLACE ALL CHARACTERS LESS THAN SPECIFIED CHARACTER WITH NEW CHARACTER
REPLNE	REPLACE ALL CHARACTERS (EXCEPT SPECIFIED CHARACTER) WITH A SPECIFIED CHARACTER
REQUEST	CALLABLE REQUEST COMMAND
RFFT	FAST FOURIER TRANSFORM FOR REAL TABULATED DATA
RFSN	REVERSE FAST FOURIER TRANSFORM
RNDMIZ	EMULATE BASIC LANGUAGE 'RANDOMIZE' STATEMENT (CAN BE USED TO GUARANTEE FIRST CALL TO RANF WILL RESULT IN A DIFFERENT NUMBER WITH EACH EXECUTION OF A PROGRAM)
ROOTER	GENERAL ROOT FINDER
ROUTE	CALLABLE ROUTE COMMAND
ROUTERC	SUPPLY DESCRIPTION OF ROUTE RETURN CODE
SBYT	STORE VARIABLE LENGTH BYTE
SEMICO	REPLACE DISPLAY CODE 00B WITH 77B (SEMI-COLON)
SETREW	CONVERT ALPHABETIC REWIND OPTION INTO RM OPEN AND CLOSE CODES

SHIFTA	SHIFT ARRAY A SPECIFIED NUMBER OF BITS (CROSSING OVER WORD BOUNDARIES)
SIMP	SIMPSON'S RULE INTEGRATION
SIMPUN	SIMPSON'S RULE INTEGRATION - UNEQUAL INTERVALS
SKWEZL	SQUEEZE LEFT AND REMOVE BLANKS AND 00B
SKWEZR	SQUEEZE RIGHT AND REMOVE BLANKS AND 00B
SMOOTH	LEAST SQUARES POLYNOMIAL SMOOTHING
SNCNDN	JACOBIAN ELLIPTIC FUNCTION
SPLFIT	SPLINE CURVE FIT
SQFIT	POLYNOMIAL LEAST SQUARE FIT
SSORT	FTN SHELL SORT
SSORTF	FTN CALLABLE SHELL SORT FOR TWO-DIMENSIONAL ARRAYS
SSORTI	FTN CALLABLE SHELL SORT FOR TWO-DIMENSIONAL ARRAYS
SSORTL	FTN LOGICAL SHELL SORT
STUTEE	STUDENT'S T DISTRIBUTION
SUMIT	SUM ELEMENTS OF REAL ARRAY
SWAP	SWAP TWO ARRAYS
TIMLEFT	DETERMINE CP (AND IO) TIME LEFT SINCE START OF BATCH JOB OR INTERCOM COMMAND
TRAILBZ	CHANGE TRAILING BLANKS TO ZEROS (00B)
UNHEX3	SPREAD 2 CHARACTERS INTO 3 HEX DIGITS
UNLOAD	UNLOAD A FORTRAN FILE
VALDAT	LOGICAL FUNCTION TO VALIDATE A DATE FORMAT
VALIDT	VALIDATE AN ARRAY TO SEE THAT EACH ELEMENT IS ONE OF A USER-SPECIFIED LIST
VARAH1	EIGENVALUES AND EIGENVECTORS OF A GENERAL REAL MATRIX
VARAH2	IMPROVED ESTIMATES AND BOUNDS FOR EIGENSYSTEM OF A GENERAL REAL MATRIX
VFILL	FILL AN ARRAY WITH USER-SPECIFIED WORD
WARNING	FTN-CALLABLE 'WARNING' CONTROL CARD

WEKDAY	DETERMINE THE DAY OF THE WEEK FOR ANY GREGORIAN DATE FROM OCTOBER 15, 1582 THRU FEBRUARY 28, 4000
XFIL	FILON'S METHOD FOR INTEGRALS WITH SIN AND COS
ZBLANK	CHANGE BLANKS TO 00B AND VICE VERSA
ZEROFL	ZERO FIELD LENGTH (SECURITY EOJ)
ZEROS	REPLACE BLANKS WITH (DISPLAY CODE) ZEROS, MULTIPLE FIELDS
ZPFPUT	PUT USER-SPECIFIED PARAMETERS INTO ARRAY FOR LATER CALL TO ZPFUNC
ZPFUNC	CALLABLE PERMANENT FILE FUNCTIONS
ZRTPUT	PUT USER-SPECIFIED PARAMETERS INTO ARRAY FOR LATER CALL TO ROUTE
ZSYSEQ	FORTTRAN CALLABLE SYSTEM CALL

## SANDIA

'SANDIA' IS A LIBRARY OF ORDINARY DIFFERENTIAL EQUATION SOLVERS OBTAINED FROM SANDIA LABORATORIES THROUGH THE ARGONNE CODE CENTER.

REFERENCE: SEE USER SERVICES.

ROUTINES IN LIBRARY 'SANDIA' INCLUDE:

DE	ORDINARY DIFFERENTIAL EQUATION SOLVER (DRIVER)
DEROOT	INTEGRATES AN INITIAL VALUE PROBLEM FOR ORDINARY DIFFERENTIAL EQUATIONS UNTIL A ROOT IS LOCATED (DRIVER)
STEP	ADAM'S INTEGRATION (USED DE AND DEROOT BUT MAY BE CALLED BY THE USER)

## \*\*\* SUBPROGRAMS IN SYSTEM LIBRARIES \*\*\*

THE FOLLOWING SUBPROGRAMS ARE IN SYSTEM LIBRARIES. SEE THE INDIVIDUAL DOCUMENTS FOR EXECUTE INFORMATION.

INDIVIDUAL DOCUMENTS MAY BE PRINTED BY:

BEGIN,DOCGET,,OTHER,,<RTN>,OUTPUT.

WHERE <RTN> IS THE NAME OF THE ROUTINE WHOSE DOCUMENTATION IS DESIRED. THE LENGTH OF EACH DOCUMENT IS GIVEN IN PARENTHESES.

MACHINE GET THE 4-WORD SYSTEM BATCH HEADING

SKPFIL REPOSITION A SEQUENTIAL FILE FORWARD OR BACKWARD A SPECIFIED NUMBER OF UNITS (FOR EXISTING RECORDS ONLY)

SKPSTAT GET THE STATUS OF THE LAST CALL TO 'SKPFIL'

## \*\*\*\*\* CATALOGUED PROCEDURES \*\*\*\*\*

A CATALOGUED PROCEDURE IS A SET OF CONTROL CARDS WHICH ACCOMPLISH A TASK. THE COMPUTER CENTER MAINTAINS ONE LIBRARY OF PROCEDURES. THIS CHAPTER DESCRIBES THIS LIBRARY AND LISTS ITS CONTENTS WITH DESCRIPTIVE TITLES.

MOST PROCEDURES ARE EXECUTED BY:

BEGIN,<PROCNAME>,<PROCFIL>,<PARAMETERS>.

WHERE <PROCNAME> IS THE PROCEDURE NAME  
<PROCFIL> IS THE PROCEDURE FILE  
(OMITTED IF 'PROCFIL')  
<PARAMETERS> IS 0 OR MORE PARAMETERS FOR THE PROCEDURE.

## \*\*\* PROCFIL \*\*\*

'PROCFIL' IS A LIBRARY OF GENERAL-PURPOSE PROCEDURES WRITTEN AT DTNSRDC. THEY ARE EXECUTED BY:

BEGIN,<PROCNAME>,,<PARAMETERS>.

REFERENCES: CLIB/P, WHICH MAY BE OBTAINED FROM USER SERVICES.

MACHINE-READABLE DOCUMENTATION MAY BE PRINTED USING PROCEDURE 'DOCGET' (SEE PAGE 1-2). MOST DOCUMENTS ARE 1 OR 2 PAGES LONG.

THE FOLLOWING PROCEDURES ARE AVAILABLE:

ADDEXT	MODIFY PRIVATE PACK DUM FILE FOR LEVEL 508 DUMPF/LOADPF
ANYLIB	EXECUTE A PROGRAM ON ANY EDITLIB USER LIBRARY
ANYPRO	EXECUTE A PROCEDURE ON ANY CATALOGUED RANDOM PROCEDURE FILE
ANYPROS	EXECUTE A PROCEDURE ON ANY CATALOGUED SEQUENTIAL PROCEDURE FILE
AUDIT	SORTED USER AUDIT
BANNERS	PRINT A PAGE WITH 1 TO 8 BANNERS
BDT	PRINT A BANNER PAGE WITH DATE AND TIME
BIGLOAD	CREATE AN ABSOLUTE FILE WHICH WILL ALLOW SOME LARGE PROGRAMS TO LOAD IN LESS CORE THAN NORMALLY NEEDED
BR2CCL	CONVERT SEQUENTIAL (UNIVERSITY OF WASHINGTON) BEGIN/REVERT PROCEDURE FILE TO SEQUENTIAL (CDC-SUPPORTED) CYBER CONTROL LANGUAGE FILE AND, OPTIONALLY, CATALOG THE CCL FILE



B7700S PREPARE 9-TRACK EBCDIC TAPE TO MOVE A SINGLE CARD-IMAGE PERMANENT FILE FROM THE CDC 6000 TO THE BURROUGHS B7700

B7700U PREPARE 9-TRACK EBCDIC TAPE TO MOVE A SINGLE DECK OR ALL DECKS IN AN UPDATE LIBRARY FROM THE CDC 6000 TO THE BURROUGHS B7700

CALC3D THREE-D PROCEDURE FOR CALCOMP PLOTTERS

CCNOTE PRINT A COMPUTER CENTER NOTE OR THE CCN INDEX

COMQ PREPARE AND ROUTE A FILE TO THE MICROFICHE QUEUE

COPYBLK REBLOCK STRANGER TAPES TO SCOPE STANDARD FILES (BOTH UNBLOCKED CARD AND PRINT LINE IMAGE TAPES AND BLOCKED STRANGER TAPES)

COPYLIB CONDENSE (AND SORT) AN EDITLIB USER LIBRARY PRESERVING AL, FL, FLO VALUES. BINDEXT AND LISTBIN LISTS ARE PROVIDED.

COPYS ATTACH, EXECUTE AND RETURN THE RIQSCOPYS PROGRAM

CV029 CONVERT TO 029 PUNCH CODE

DISPOST INVOKE THE TEKTRONIX POSTPROCESSOR

DOCADD ADD ONE DOCUMENT TO A DOCUMENTATION FILE

DOCDATE LIST DOCUMENT NAMES (ON \*DECK CARDS) TOGETHER WITH THE DOCUMENT DATE AND PAGE NUMBERS (FROM BOTTOM LINE OF EACH PAGE)

DOCDELE DELETE ONE DOCUMENT FROM A DOCUMENTATION FILE

DOCDOC LIST DOCUMENTATION FOR PROCEDURES DOCADD, DOCDATE, DOCDELE, DOCDOC, DOCFILE, DOCGET, DOCLIST, DOCREPL

DOCFILE ATTACH A DOCUMENTATION FILE

DOCGET GET (EXTRACT) SPECIFIED DOCUMENT FROM A DOCUMENTATION FILE

DOCLIST LIST DOCUMENT NAMES (ON \*DECK) CARDS IN A DOCUMENTATION FILE

DOCREPL REPLACE ONE DOCUMENT IN A DOCUMENTATION FILE

DOCTAPE EXTRACT (PRINT) ONE OR ALL DOCUMENTS FROM A DOCUMENT FILE ON TAPE

GETPROD GET PRODUCTS FILE(S) FOR NOS/BE LEVELS 461, 439, 434, 420, 414, 410, 406, 401, 380

GRIPE ALLOW USER TO MAKE GRIPES OR SUGGESTIONS DIRECTLY TO THE COMPUTER

LGOTREE	GENERATE CROSS-REFERENCE LISTS AND TREE STRUCTURE FROM BINARY RELOCATABLE OBJECT FILE
LIBPRO	EXECUTE A PROCEDURE ON LIBRARY 'PROCFIL' CATALOGED UNDER ANY ID
LIBPROA	EXECUTE A PROCEDURE ON ANY CATALOGUED PROCEDURE LIBRARY
LIBSET1	CREATE SIMPLE ABSOLUTE USING ONE EDITLIB LIBRARY
LIBSET2	CREATE SIMPLE ABSOLUTE USING TWO EDITLIB LIBRARIES
LINE6	SET PRINT FILE TO 6 LINES PER INCH
LINE8	SET PRINT FILE TO 8 LINES PER INCH
LIST	LIST A PERMANENT FILE
MANUAL	PRINT ONE COPY OF A MANUAL OR ITS REVISION PAGES
MFx	LIST THE MACHINE BEING USED
MNSRDC	EXECUTE A PROGRAM ON EDITLIB USER LIBRARY 'MNSRDC'
MYPRO	EXECUTE A PROCEDURE ON SEQUENTIAL FILE 'PROCFIL' CATALOGED UNDER ANY ID
MYPROS	EXECUTE A PROCEDURE ON SEQUENTIAL FILE 'PROCFILS' CATALOGED UNDER ANY ID
NOGO	CREATE SIMPLE ABSOLUTE FROM RELOCATABLE
NORERUN	INSURE THAT A BATCH JOB CANNOT BE RERUN BY OPERATOR TYPE-IN
PAC	PURGE ALL CYCLES OF A FILE
PAHC	PURGE ALL HIGH CYCLES OF A FILE WHILE RETAINING THE LOW CYCLE
PALC	PURGE ALL LOW CYCLES OF A FILE WHILE RETAINING THE HIGH CYCLE
PFRSTOR	CREATE A FILE OF DIRECTIVES TO RESTORE PERMANENT FILES
PFTRAN1	INVOKE PFTRANS TO TRANSFER ONE FILE
PGMTAPE	EXTRACT A SOURCE PROGRAM FROM TAPE
PHC	PURGE HIGH CYCLE OF A FILE WHILE RETAINING THE LOW CYCLE
PLC	PURGE LOW CYCLE OF A FILE WHILE RETAINING THE HIGH CYCLE
PM	CREATE CERTAIN PRINT MESSAGE (PM) RECORDS

PROADD     ADD ONE PROCEDURE TO A SEQUENTIAL PROCEDURE FILE

PROALL     LIST PROCEDURE NAMES, PROCEDURE HEADERS AND THE PROCEDURES IN  
A SEQUENTIAL PROCEDURE FILE (COMBINES PRONAM, PROHDR AND  
PROLIST)

PRODELE    DELETE ONE PROCEDURE FROM A SEQUENTIAL PROCEDURE FILE

PRODOC     LIST DOCUMENTATION FOR PROCEDURES PROADD, PROALL, PRODELE,  
PRODOC, PROGET, PROHDR, PROLIST, PRONAM, PROREPL, PROS2R

PROGET     GET (EXTRACT) ONE PROCEDURE FROM A SEQUENTIAL PROCEDURE FILE

PROGRAM    EXECUTE A CATALOGED PROGRAM (NOT IN A LIBRARY)

PROHDR     LIST PROCEDURE HEADERS IN A PROCEDURE FILE

PROLIST    LIST PROCEDURE(S) IN A SEQUENTIAL PROCEDURE FILE

PRONAM     LIST NAMES OF PROCEDURES IN A SEQUENTIAL PROCEDURE FILE

PROREPL    REPLACE ONE PROCEDURE IN A SEQUENTIAL PROCEDURE FILE

PROS2R     CONVERT SEQUENTIAL PROCEDURE FILE TO RANDOM EDITLIB USER  
LIBRARY

PURGALL    PURGE PERMANENT FILES OF SPECIFIED AC AND ID

PURGEN     GENERATE PROCEDURE 'PUR' TO PURGE SEVERAL FILES WITH COMMON  
KERNEL

RECADD1    ADD ONE OR MORE LOGICAL RECORDS TO A FILE

RECDEL1    DELETE ONE OR MORE LOGICAL RECORDS FROM A FILE

RECDOC     LIST DOCUMENTATION FOR PROCEDURES RECADD1, RECDEL1, RECDOC,  
RECGET1, RECREP1

RECGET1    EXTRACT ONE OR MORE LOGICAL RECORDS FROM A FILE

RECREP1    REPLACE ONE OR MORE LOGICAL RECORDS IN A FILE

RENAMAC    RENAME AC FIELD ON PERMANENT FILES

RUNBAS     COMPILE AND EXECUTE BASIC PROGRAM (SIMILAR TO EDITOR RUN,BAS  
FOR USE OUTSIDE OF EDITOR)

RUNFTN     COMPILE AND EXECUTE FTN PROGRAM (SIMILAR TO EDITOR RUN,FTN  
FOR USE OUTSIDE OF EDITOR)

RUNMNF     COMPILE AND EXECUTE MNF PROGRAM UNDER INTERCOM

RUNPAS	COMPILE AND EXECUTE PASCAL PROGRAM UNDER INTERCOM
RUNSEQ	COMPILE AND EXECUTE FTN,SEQ PROGRAM
RUNTS	COMPILE AND EXECUTE FTN,TS PROGRAM
SEGLD	CREATE A SEGLOAD ABSOLUTE FILE
SELDUMP	CREATE BACKUP DUMP TAPE OF THE USER PERMANENT FILE OF AN ACCOUNT NUMBER
SELLOAD	RESTORE SELECTED ROUTINES FROM A BACKUP DUMPF TAPE
SEND	SEND MESSAGES TO AN INTERCOM USER WHO IS NOT LOGGED IN; LIST MESSAGES
SORT	INVOKE SORTMRG TO SORT UP TO 5 'DISPLAY' FIELDS USING 'COBOL6' COLLATING SEQUENCE
SORTCZ	INVOKE SORTMRG TO SORT UP TO 5 'DISPLAY' FIELDS IN BT=C,RT=Z RECORDS USING 'COBOL6' COLLATING SEQUENCE ('FILE' CARDS NOT REQUIRED)
S2K260	ATTACH FILES FOR S2000 (VERSION 2.60) NATURAL LANGUAGE, FORTRAN, OR COBOL PRECEDURAL LANGUAGE INTERFACE
TIDBITS	LIST FILE OF TIDBITS (HINTS ON IMPROVED COMPUTER USAGE)
TRANPAK	COPY CONTENTS FROM ONE DEVICE SET TO ANOTHER FOR BACKUP
UPDADD	ADD ONE DECK TO AN UPDATE LIBRARY
UPDDELE	DELETE ONE DECK FROM AN UPDATE LIBRARY
UPDDOC	LIST DOCUMENTATION FOR PROCEDURES UPDADD, UPDDELE, UPDDOC, UPDGET, UPDLIST, UPDREPL
UPDGET	EXTRACT ONE DECK FROM AN UPDATE LIBRARY (UPDATE,C) AND, OPTIONALLY, ADD EDITOR SEQUENCING
UPDGETS	EXTRACT ONE DECK FROM AN UPDATE LIBRARY (UPDATE,S) AND, OPTIONALLY, ADD EDITOR SEQUENCING
UPDGETT	EXTRACT ONE DECK FROM AN UPDATE LIBRARY (UPDATE,T) AND, OPTIONALLY, ADD EDITOR SEQUENCING
UPDLIST	LIST DECK/COMDECK NAMES IN UPDATE LIBRARY WITH COUNT OF RECORDS IN EACH DECK/COMDECK
UPDREPL	REPLACE ONE DECK IN AN UPDATE LIBRARY
UTILITY	EXECUTE A PROGRAM ON EDITLIB USER LIBRARY 'UTILITY'
VENUS	ATTACH AND EXECUTE ONE OF THE VENUS RETRIEVAL PROGRAMS
WHATLIB	LIST LIBRARIES SPECIFIED IN LAST 'LIBRARY' COMMAND

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